APPLICATION DATA INDEX

APPLICATION DATA INDEX

RENEWAL PARTS

An adequate stock of factory-made renewal parts is an integral part of a sound maintenance program to protect against costly downtime. A list of minimum recommend spare parts for one to four duplicate units in operation is contained in the Reliance Electric motor instruction manual.

Detailed information on renewal parts is contained in NEMA Standards publication No. RP1-1981 (R 1987) **Renewal parts for Motors and Generators (Performance, Selection and Maintenance).** Copies are available from NEMA, 2101 L. Street, N.W. Washington D.C. 20037

USEFUL FORMULAS

1 HP = 746 watts =.746 KW

$$HP = \frac{\text{(Torque in Lb. -Ft.) (RPM)}}{5250}$$

$$\text{TORQUE IN LB-FT} = \frac{(5250)\ (HP)}{RPM}$$

TIME REQUIRED TO CHANGE SPEED OF ROTATING MASS FROM N_1 TO N_2 RPM

$$t(\text{sec.}) = \frac{(WK^2)\ (N_2 - N_1)}{(308)\ (\text{Torque in Lb.-ft.})}$$

where WK^2 = Total inertia of motor and load

$N_2 - N_1$ = Change in speed in rpm

When calculating torque available for acceleration remember that every machine has friction. Torque available for acceleration is motor torque less machine frictional torque.

FIELD RESISTANCE

$$\text{Cold Field Resistance} = \frac{\text{Rated Field Volts}}{\text{Cold Field Amps}}$$

$$\text{Rated or Hot Field Resistance} = \frac{\text{Rated Field Volts}}{\text{Rated or Hot Field Amps}}$$

INERTIA REFLECTED TO MOTOR

$$= \text{LOAD INERTIA} \left(\frac{\text{Load rpm}}{\text{Motor rpm}}\right)^2$$

BASIC DC RELATIONSHIPS

$$\text{Torque} = KIA\phi_f$$

where K is a machine constant

I_A is a armature current

ϕ_f is field flux

$$\text{Torque (approx)} = \frac{7.04\ E_{GEN}\ ^{I}\ A}{RPM}$$

$$\text{Speed (RPM)} = \frac{V_A - I_A R_A}{K\phi_f}$$

Where V_A is armature voltage

R_A is total armature circuit resistance

MOTOR

$$V_A = E_{GEN} + I_A R_A$$

Where $E_{GEN} = E_{CEMF} = K\phi\ (RPM)$

GENERATOR

$$V_T = E_{GEN} - I_A R_A$$

Where V_T is Terminal (output) voltage

TEMPERATURE CONVERSION

(F^o TO C^o) $C^o = 5/9\ (F^o - 32^o)$

(C^o TO F^o) $F^o = 9/5\ C^o + 32^o$

APPLICATION DATA

SAFETY

DC motors have characteristics which can cause serious or fatal injury unless they are selected, installed, maintained and operated by qualified personnel familiar with special requirements of DC machines. Reliance Electric DC motors are designed and built in accordance with **Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators,** National Electric Manufacturers Association (NEMA) publication MG 2. Reliance Electric recommends that this publication be referred to whenever you select or install any motor. Copies can be obtained from NEMA, 2101 L Street, N.W., Washington, D.C., 20037. In addition, all motors must be installed in accordance with the National Electric Code and applicable local codes.

Primary consideration in selecting and applying DC motors must be given to protection of personnel from mechanical and electrical hazards. This catalog presents some of the precautions to observe in specifying and using DC motors. Additional considerations are given in the instruction manual for a specific motor rating which must be observed by the personnel installing, operating and maintaining the equipment.

Enclosures

The selection of the proper enclosure is vital to the successful safe operation of DC motors and generators. The wrong enclosure can pose hazards to operating personnel and endanger other equipment. In addition, machine performance and life can be materially reduced by using an enclosure inappropriate for the application. The customer must recognize the specific environmental conditions and specify the correct enclosure. Reliance Electric can provide application assistance but must depend on the customer to provide accurate information on the operating conditions.

The information in this section, the **General Information Section** and the Modification Section should be studied thoroughly before specifying an enclosure.

As indicated in the **General Information Section**, the basic DC motor may be Drip-proof Guarded, Drip-proof Guarded Force Ventilated or Drip-proof Guarded Separately Ventilated depending on horsepower rating. In addition, totally enclosed motors can be supplied when required by the application. The minimum enclosure for Reliance Electric DC motors is Drip-proof Guarded (DPG) as defined by NEMA MG1-1.25.5 to prevent accidental exposure to live metal or rotating parts. The drip-proof construction permits successful operation when drops of liquid or solid particles strike or enter the enclosure at any angle from 0 to 15 degrees downward from the vertical. Certain applications may require a Splashproof Guarded (SPG) machine to permit successful operation when drops of liquid or solid particles strike or enter the enclosure at any angle not greater than 100 degrees downward from the vertical.

Both Drip-proof Guarded and Splashproof Guarded machines may have a blower driven by a constant speed AC motor mounted on the end bracket to provide cooling independent of DC motor speed. See M-329 **(Speed Range by Armature Voltage Control)**. A filter may be added to the blower when filterable contaminants are present in amounts not sufficient to rapidly clog the filter. A filter is not recommended in extremely dusty, dirty locations.

For dusty, dirty environments, a totally enclosed machine is required to prevent the free exchange of air between the inside and outside of the enclosure but not sufficiently enclosed to be termed air-tight. The following totally enclosed machines are available and may be priced from either the Pricing Section or the **Modification Section.**

Totally Enclosed Non-Ventilated - Not equipped for cooling by means external to the enclosing parts. Generally limited to low horsepower ratings or short-time rated machines.

Totally Enclosed Fan Cooled - Exterior surface cooled by external fan on motor shaft. Available in ratings thru 75 HP at 1750 rpm. Motor cooling is dependent on motor speed.

Totally Enclosed Air-Over In-line - External fan driven by constant speed AC motor flange mounted to motor fan shroud. Provides cooling independent of motor speeds. Brakes and tachometers cannot be mounted on motor end bracket except for specific small tachometers which can be nested between motor bracket and fan. Available thru C400ATZ frames.

Totally Enclosed Air-Over Piggyback - Has top mounted AC motor driven blower shroud to direct ventilating air over motor frame. Available thru C400ATZ frame.

Totally Enclosed Dual-Cooled with Air-to-Air Heat Exchanger (TEDC-A/A) - Cooled by circulating motor internal air thru the heat exchanger by an AC motor driven blower. External air circulated thru the heat exchanger by another AC motor driven blower removes heat from the circulating internal air. No free exchange of air occurs between the inside and outside of the motor.

Totally Enclosed Dual-Cooled with Air-to-Water Heat Exchanger (TEDC-A/W) - Similar to TEDC A/A except external circulating air flow is replaced by customer supplied water to remove heat from heat exchanger. Available in ratings thru 3000 HP.

Totally Enclosed Pipe-Ventilated (TEPV) or Totally Enclosed Separately-Ventilated (TESV) - Motor is cooled by customer supplied air which is piped into the machine and ducted out of the machine by customer supplied ducts.

Explosion-Proof - An Explosion-Proof machine is a totally enclosed machine whose enclosure is designed and constructed to withstand an explosion of a specified gas or vapor which may occur within it and to prevent the ignition of the specified gas or vapor surrounding the machine by sparks, flashes or explosions of the specified gas or vapor which may occur within the machine casing. See next page (Hazardous Locations) and Pricing Section for application information.

Dust-Ignition-Proof Machine - A dust-ignition-proof machine is a totally enclosed machine whose enclosure is designed and constructed in a manner which will exclude ignitable amounts of dust or amounts which might affect performance or rating, and which will not permit arcs, sparks, or heat otherwise generated or liberated inside of the

(Continued)

Enclosures (cont')

enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specific dust on or in the vicinity of the enclosure. See below (Hazardous Locations) and Pricing Section for application information.

In addition to the foregoing basic enclosures, Reliance Electric offers the following modifications to Totally Enclosed machines for use in specific locations. Refer to Modification Section for complete description.

Enclosure Enhancements

Dust-Proof Taconite Features - Provides bearing protection against fine abrasive dust such as taconite.

XT Features - Provides protection against corrosive, moist and dirt laden environments as encountered in paper, chemical and similar industries. Applicable to totally enclosed motors only.

The Reliance XT motor is designed for operation in damp locations where the motor will be subjected to corrosive conditions. Typical applications are paper, chemical, petroleum, fertilizer and plastics industries.

XT motors are provided in totally enclosed non-ventilated, totally enclosed fan-cooled, totally enclosed separately-ventilated, totally enclosed air-over and totally enclosed dual-cooled enclosures.

XT Motor Construction Includes The Following Features:

- Exterior surface of frame painted with epoxy enamel
- Interior surfaces are epoxy coated
- Armature and shaft (except shaft extension) are epoxy coated
- Stainless steel or neoprene slinger mounted on external shaft extensions
- External fan on TEFC motors is plastic or epoxy coated cast iron
- Fan cover on TEFC motors is finished with epoxy enamel
- Corrosion resistant T-drains provided for positive drain
- Assembled motor with mounted accessories painted with epoxy enamel
- Conduit box has neoprene gaskets on cover and box frame
  Box construction is -
  DC180ATZ - C360ATZ - Epoxy coated cast iron with pipetap lead outlet
  C400ATZ and up - Epoxy coated mill type
- Bracket to frame rabbet fit sealed with special sealing compound
- Handhole covers sealed with neoprene gaskets
- All hardware corrosion resistant
- Stainless steel nameplate
- All external bolt heads sealed - includes bearing cap bolts, main field pole an dinterpole bolts
- Unused lifting eye bolts sealed - Frames C180ATZ-C440ATZ

XT construction avoids the use of exposed aluminum parts. The exception is totally enclosed dual-cooled air-to-air heat exchangers which have aluminum tubes. Contact Reliance Electric Sales Engineers for information on alternative materials.

Motor accessories such as brakes must be specified and priced at totally enclosed construction for XT motors.

Motors located in damp, moist environments must have space heaters or the fields energized at reduced (usually 50%) voltage to protect against condensation when the motor is not operating.

Motors operating in dirty areas with fine abrasive dust such as taconite surrounding the motor should have Dustproof-taconite features added in addition to this modification.

Outdoor Duty/Weather Proof/Washdown - This modification provides a motor suitable for operation outdoors subject to direct weather conditions. Applicable enclosures are totally enclosed non-ventilated, totally enclosed fan-cooled, totally enclosed separately-ventilated, totally enclosed air-over and totally enclosed dual cooled. Outdoor duty motors include the features of XT motors plus extended hoods over the fan inlets on TEFC, TEAO and TEDC enclosures to prevent water being blown over the frame by the fan or blower. Additional sealing around the hand hole covers is provided to prevent entrance of water applied from a hose. Totally enclosed dual-cooled enclosures have aluminum tubes. For outdoor and indoor applications containing contaminants corrosive to aluminum, contact Reliance Electric Sales Engineers for information on alternative materials. Outdoor duty motors must have space heaters or the fields energized at reduced (usually (50%) voltage to protect against condensation when the motor is not operating. Motor accessories such as brakes must be specified and priced as suitable for outdoor use. Standard tachometers are not recommended for outdoor duty. Motors operating in dirty areas with fine abrasive dust such as taconite surrounding the motor should have Dustproof/ taconite features added in addition to this modification.

Washdown duty motor must have lip seal modification added for each exposed external shaft extension.

Paper Mill Duty Features - Designed for operation at the wet end of a paper mill and in other harsh industrial environments.

The Reliance paper mill duty motor is designed for operation at the wet end of a paper mill and in other harsh industrial environments. This modification can be provided on separately-ventilated, force-ventilated, dripproof or totally enclosed motors.

Paper Mill Duty Motor Construction Includes The Following Features:

- Exterior surface of frame painted with epoxy enamel
- Interior surfaces are epoxy coated
- Armature and shaft (except shaft extension) are epoxy coated
- Stainless steel or neoprene slinger mounted on external shaft extensions
- External fan on TEFC motors is plastic or epoxy coated cast iron
- Fan cover on TEFC motors is finished with epoxy enamel.
- Corrosion resistant T-drains provided for positive drain, on totally enclosed motors
- Assembled motor with mounted accessories painted with epoxy enamel

(Continued)

Enclosure Enhancements (cont.)

- Conduit box - Neoprene gaskets on cover and box frame. Box construction is -
  C180ATZ-C360ATZ - Epoxy coated cast iron with pipe tap lead outlet
  C400-B1600 - Epoxy coated mill type with pipe flanges for conduit connection
  Optional at additional cost
  Mill type for frames C180ATZ-C360ATZ
  Oversize mill type for frames C400ATZ-B960ATZ
- Bracket to frame rabbet fit sealed with special sealing compound
- Handhole covers sealed with neoprene gaskets
- All hardware corrosion resistant
- Stainless steel nameplate
- All external bolt heads sealed - includes bearing cap bolts, main field pole and interpole bolts
- Unused lifting eye bolts sealed - Frames C180ATZ-C440ATZ
- Special brush grade to provide more cleaning action for paper mill environments (when required - usually on lower horsepower ratings)

Paper mill duty construction avoids the use of exposed aluminum parts. The exception is totally enclosed dual-cooled air-to-air heat exchangers which have aluminum tubes. Contact Reliance Electric Sales Engineers for information on alternative materials.

Motor accessories such as brakes must be specified and priced as totally enclosed construction for paper mill duty motors.

Motors located in damp, moist environments must have space heaters or the fields energized at reduced (usually 50%) voltage to protect against condensation when the motor is not operating.

Splash proof covers should be added to dripproof motors.

Totally enclosed motors operating in dirty areas with fine abrasive dust such as taconite surrounding the motor should have Dustproof/taconite features added in addition to this modification.

Crane & Hoist Duty (C180ATZ - C440ATZ) - The Reliance Outdoor Crane & Hoist duty motor provides severe duty features for crane duty motors such as Hoist, Gantry and Trolley motors.

Crane & Hoist duty motor construction includes the following features:

- All features of Outdoor Duty (IP55)
- Shaft seals
- Machined fits painted during motor assembly
- Additional fasteners utilized on heavy duty hand hole cover to insure tight seal
- All interior and exterior surfaces painted with epoxy enamel
- All exterior surfaces receive a minimum of 4 coats of paint
- Lockwashers and loctite on all external fasteners

Lifting Precautions

The lifting of motors and generators is a potentially hazardous operation requiring care and knowledge of proper lifting technique to assure safety of personnel and to prevent damage to the equipment. Specific lifting instructions given in the instruction manual and on a plate attached to the motor frame must be followed.

An experienced rigger should be employed to handle all large motors and any unusual mounting conditions such as side-wall and ceiling mounting of horizontal motors and installation of vertical motors shipped in a horizontal position.

Hazardous Locations

1. Explosion-Proof and Dust-Ignition-Proof Motors

The application of motors and generators and other electrical equipment in hazardous locations is restricted by the National Electrical Code, Article 500. Customers must observe these regulations and consult with local code inspection and enforcement agencies to insure compliance. Motors listed by Underwriters Laboratories for use in specific hazardous locations are listed for use in the specified location only.

Reliance Electric DC motors are listed by Underwriters Laboratories for use in specific hazardous locations according to the following classifications:

Class I - A hazardous location in which a flammable gas or vapor is present in the atmosphere. An explosion-proof motor is suitable for this location.
Class II - A hazardous location in which a flammable dust is present in the atmosphere. A dust-ignition-proof motor is suitable for this location.

The specific dust or gas present in the hazardous location is identified by the group listing for each Class. Certain Reliance Electric DC motors are listed for use in Class I Groups C and D and Class II Groups E, F and G locations depending on the horsepower rating, frame size and enclosure as indicated on the basic price pages for explosion-proof and dust-ignition-proof motors. The user customer is responsible for insuring that the proper UL listed motor is used in a specific hazardous location. The user customer is also responsible to insure compliance with the National Electrical Code and applicable local codes if a permissible alternate to a UL listed motor is used in a hazardous location.

2. Totally Enclosed Pipe-In, Pipe-Out Ventilated motors for Class I Division 2 Locations

Section 501-8 of the National Electric Code permits the use of totally enclosed motors with pipe-in, pipe-out ventilation in Class I Division 2 locations when installation and operation conform to certain requirements. Motors must be air-purged (separately ventilated) with a source of clean air free of the hazardous gas and the control must be

(Continued)

Hazardous Locations (cont.)

arranged to prevent energization of the machine until ventilation has been established and the enclosure has been purged with at least 10 volumes of air. Protective devices such as a thermostat must be utilized in the motor to detect any increase in temperature of the motor beyond the acceptable temperature limits and the control must be arranged to automatically de-energize the equipment. Motor leads must be sealed at the frame exit. (See NEC Section 501-5.)

Auxiliary equipment such as conduit box, tachometer and other auxiliary devices mounted on the motor must be of the explosion-proof type for Class I locations.

Pipe-in, pipe-out ventilated motors supplied for use in hazardous locations do not have an Underwriters' label and are not explosion-proof. The user customer is responsible for insuring that the installation meets the requirements of the National Electric Code and applicable local codes.

The following guidelines must be followed in selecting and installing non-explosion-proof motors in hazardous locations.

1. Available for Division 2 Class I Group D applications only with temperature code T2D. All orders must identify the specific Group, Division and Temperature Code for the location. (1)
2. Limited to ratings 200 HP and smaller due to availability of explosion-proof conduit box.(1)
3. Enclosure must be separately ventilated. Order must specify the air-in and air-out locations. Customer must provide ventilating air at the volume and static pressure indicated on the motor nameplate.
4. Explosion-proof Conduit Box must be added. This modification provides an explosion-proof conduit box, three thermostats connected internally in the motor, and a separate warning plate with the following information
5. The thermostat leads (P1 and P2) must be connected in the control to automatically de-energize the motor if motor temperature increases beyond the design limits. (Refer to Mod. 410 for thermostat contact rating.)
6. Auxiliary equipment on the motor including tachometer and brake must be UL listed for Class I and Group D
7. An explosion-proof air pressure switch is required to provide an immediate indication of cooling air loss

WARNING!

THIS MOTOR IS NOT EXPLOSION-PROOF BUT IS SUITABLE FOR USE IN HAZARDOUS LOCATIONS WITH DESIGNATION OF CLASS I GROUP DIVISION AND TEMPERATURE IDENTIFICATION CODE PROVIDED THE FULL REQUIREMENTS OF THE NATIONAL ELECTRIC CODE (NFPA 70) AND LOCAL CODES CONCERNING PERIPHERAL EQUIPMENT ARE MET BY THE USER/INSTALLER WITHOUT INVOLVEMENT BY THE RELIANCE ELECTRIC COMPANY.

(1) For ratings above 200 HP and for Class I Groups A, B or C and Class II applications, contact Reliance Electric Sales Engineers

Protection from Electrical Shock

To provide maximum protection from electrical shock inherently possible with the high voltage, high current power requirements of DC motors, the following precautions and procedures must be followed:

- **Enclosure** - All enclosures must be at least drip-proof guarded to help protect personnel from accidental contact with live electrical parts. All covers and guards must be in place.
- **National Electric Code** - All motors and generators must be installed and protected in accordance with the National Electric Code and applicable local codes.
- **Grounding** - The frames of motors and generators should be grounded to limit their potential to ground in the event of accidental connection or contact between live electrical parts and exterior motor surfaces. All Reliance DC motors have a provision for a ground connection. Good electrical contact must be maintained to this grounding surface.
- **Wiring Connections** - All connections to the machine must be made by qualified personnel in accordance with the connection diagram for the specific machine.
- **Overtemperature and Overcurrent Protection** - Equipment must have proper overtemperature and overcurrent protection devices with manual reset. Automatic reset devices may endanger operating and maintenance personnel.
- **Maintenance** - Motors and generators must be properly maintained. Maintenance personnel must be qualified to work on DC equipment. They must remember that internal parts may be at line potential even when the machine is not rotating. Before performing any maintenance which could result in contacting any internal part, they must disconnect all power from the motor:
  - **Motors using rectified power units -** disconnect all AC line connections, including accessories such as space heaters.
  - **Motors using rotating power units -** disconnect all DC line and field connections and accessory AC line connections.

Maximum Safe Speed

DC motors are inherently capable of reaching speeds hazardous to personnel and equipment if improperly connected or misapplied. Operation of a shunt wound or compound wound motor without the shunt field energized at the proper current may cause the motor to reach a dangerous speed. Both the motor instruction manual and the control instruction manual must be followed when the motor is being connected and operated and the work must be performed by qualified personnel.

Protective devices such as overspeed switches, field loss relay or tachometers must be used in the control circuit to limit motor speeds to the values given in Table I unless the motor speed is limited by the application.

The speeds given in Table I are the maximum mechanically safe operating speeds for frames with standard construction. **These speeds must not be exceeded under any condition.** Motor control must hold the maximum speed under any load condition including no-load within the maximum safe speed. Drive systems whose design characteristics inherently prevent the DC motor from exceeding the Motor Maximum Safe Operating Speed must prevent the motor from exceeding the Maximum Safe Speed if a single component failure should occur.

(Continued)

Maximum Safe Speed (cont.)

TABLE I - Maximum Safe Speed

Frame Diameter	Maximum Safe Speed rpm	Frame Diameter	Maximum Safe Speed rpm
DC180ATZ	4500	C5010ATZ	2200
DC2112ATZ	4500	C5011ATZ	2200
C180ATZ	5000	C5012ATZ	2175
C210ATZ	4500	C5013ATZ	1875
C2512ATZ	4500	B500ATZ	2650
C2514ATZ	4500	B509ATZ	2450
C2515ATZ	3400	B5010ATZ	2155
C2812ATZ	4500	B580ATZ	2475
C2813ATZ	4000	BB589ATZ	2200
C2815ATZ	3400	BB5810ATZ	2030
C3210ATZ	3600	B680ATZ	2100
C3212ATZ	3600	B689ATZ	1930
C3214ATZ	3600	B840AT	1720
C3612ATZ	3400	B960AT	1600
C3613ATZ	3200	B1200AT	1600
C400ATZ	3000	B1400AT	1400
C440ATZ	2450	B1600AT	1200

With special construction maximum safe speed may differ from the above values. In all cases, the maximum safe speed is indicated on the motor nameplate.

Note: Normal operating speeds must be limited to those listed in Pricing Section in order to meet nameplate rating and assure validity of warranty.

WARNING!

THE MACHINERY BUILDER IS RESPONSIBLE FOR INSURING THAT DRIVEN MACHINERY AND ALL DRIVETRAIN MECHANISMS NOT SUPPLIED BY RELIANCE ELECTRIC AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT THE MAXIMUM SPEEDS, AS SHOWN IN TABLE I. FAILURE TO DO SO CAN RESULT IN DESTRUCTION OF MECHANISM OR MATERIAL AND FLYING FRAGMENTS, ENDANGERING OPERATING PERSONNEL.

Protection from Rotating Shafts, Couplings and Sheaves

All shafts, couplings, sheaves and other rotating elements connected to the motor shaft must be covered with proper protective covers to guard against accidental contact when the motor is operating. Special attention should be given to second shaft extensions which may have been specified for future use but not used initially.

The precautions given on page M-333 (Belted Applications) must be observed to insure proper specification of pulleys, sheaves, sprockets and gears on motor shafts.

Motor Frame Temperature

Drip-proof guarded force ventilated or drip-proof guarded DC motors rated Class F temperature rise are allowed an insulation temperature rise of 90° C measured by thermometer (130°C measured by resistance) above the 40°C ambient or total temperature of 130°C. Totally enclosed motors may have a 95°C rise or a total insulation temperature of 135°C by thermometer. With these allowable NEMA temperature rises, the motor frame may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with these hot surfaces. In general, TENV enclosures will have higher surface temperatures than DPG, TEFC or DPFV enclosures. When installing, the customer must provide protection against accidental contact with the hot frame surface.

LOCATION

Air Supply

Cooling air through a self-ventilated or forced-ventilated motor must be clean and have relative humidity between 30% and 100% with no free water in the air. Use of damp, cool outside air with high humidity and free water may cause the motor to flash over. Use of excessively dry air may cause excessive brush and commutator wear. Cooling air temperature must not exceed the maximum ambient temperature indicated on the motor nameplate (Standard 40° C). Cooling air temperature must not be lower than 0° C to provide base speed and regulation within NEMA limits. Use of outside air below 0-C may cause excessive brush and commutator wear due to the low humidity. Cooling air absolute humidity must be at least 2 grains per cu. ft.

Note: *Motors located in damp, moist environments must have space heaters or fields energized at 50% voltage to protect against condensation when motor is not operating.*

(Continued)

Separately ventilated motors must have the following volume of air to adequately cool the motor unless the motor nameplate specifies a different value.

Frame	Base Speed, rpm	Air Volume Cfm.	Static Pressure Inches of Water
DC180ATZ and	2500	152	2.00
C180ATZ	1750 and lower	105	0.95
C2113ATZ	All	300	2.25
C2115ATZ	All	290	4.1
C2512ATZ	All	425	2
C2514ATZ	All	385	3.4
C2515ATZ	All	385	3.4
C2812ATZ	All	550	3.25
C2813ATZ	All	530	3.75
C2815ATZ	All	530	3.75
C3210ATZ	All	800	3.5
C3212ATZ	All	800	3.5
C3214ATZ	All	700	4
C3612ATZ	All	1,000	4
C3613ATZ	All	950	5.1
C400ATZ	All	1,200	4
C440ATZ	All	1,960	7.5
C500ATZ	All	2,500	4
B506ATZ	All	1,200	1.75
B507ATZ	All	1,200	1.75
B508ATZ	Except 1750 At 500 HP	1,200	1.75
B508ATZ	1750 - 500 HP	1,450	2
B509ATZ	All	1,450	2
B5010ATZ	All	1,450	2
B587ATZ	All Except 1750	2,000	2.25
B587ATZ	1750 - 600 HP	2,400	3.4
B588ATZ	All	2,000	2.25
B589ATZ	All	2,000	2.25
BB5810ATZ	All	2,400	3.4
B686ATZ	All	2,200	1.75
B687ATZ	All	2,200	1.75
B688ATZ	All	2,200	1.75
B689ATZ	All	2,875	3
B840AT	All	6,000	5
B960AT	All	6,500	4
B1200AT	All	8,000	3.75
B1400AT	All	10,000	4.5
B1600AT	All	12,000	2.5

Ambient

As indicated in the General Information Section, Standard RPM III and SUPER RPM DC motors are designed for continuous operation in air at maximum ambient temperatures of 40° C (104° F) and at altitudes from sea level to 3300 feet. Operation under more extreme conditions may be permissible by derating the motor output. All elements of the motor, that is, armature, shunt field, intercoil, brushes, commutator, and leads must be evaluated for maximum allowable operating conditions. When ordering, the customer should specify any unusual ambient conditions so that a motor can be supplied to give full rated continuous output under the specific ambient conditions.

MOUNTING

Motors must be mounted on a rigid, solid base or foundation. (Poor base construction may cause resonances in the motor/base assembly which can result in bearing failure and other motor damage.) All hold down bolts must be the correct grade for the type of mounting and must be torqued to their recommended value. Recommended bolt torques for SAE.

Grade 1 foot bolts are given in the following table.

Frame	Hole Diameter H Inch	Bolt Size and Thread	Recommended Torque for SAE Grade I Dry Components -Not Lubricated Foot-pounds
C180ATZ	0.44	3/8-16	16
C210ATZ	0.44	3/8-16	16
C250ATZ	0.56	1/2-13	39
C280ATZ	0.56	1/2-13	39
C320ATZ	0.69	5/8-11	77
C360ATZ	0.81	3/4-10	135
C400ATZ	1.06	7/8-9	215
C440ATZ	1.06	7/8-9	215
C500ATZ	1.19	1/8	320
B500ATZ	1.19	1/8	320
B580ATZ	1.44	1-1/4-7	640
B680ATZ	1.44	1-1/4-7	640
B840AT	1.69	1-1/2-6	1010
B960AT	1.94	1-3/4-5	1770
B1200AT	1.94	1-3/4-5	1770
B1400AT	2.19	2-4-1/2	2660
B1600AT	2.19	2-4-1/2	2660

Standard DC motors Frames DC180ATZ thru B680ATZ will operate successfully mounted on the floor, wall or ceiling, and with the shaft at any angle from horizontal to vertical. Special mountings, duty or thrust demands may however require a different bearing system. Vertical mount drip covers are required to provide protection to vertically mounted Drip-proof motors. Stock motors and other motors designed for horizontal mounting can be adapted for vertical mounting by ordering vertical mount drip covers from Reliance Electric.

Motor slide bases or rails, when used on belted drives must be securely anchored to the foundation with proper bolts. The motor shaft and the load shaft must be parallel and the sheaves aligned. Refer to page M-333 (**Belted Duty Applications**) for minimum sheave diameters.

Coupled drives must have flexible couplings between the motor shaft and the load shaft. Motor shaft and load shaft must be aligned within 0.002 inches (0.05 mm) under cold conditions before the coupling is connected. Correct alignment is vital for long life of bearings and shaft and proper operation of high performance variable speed drives.

INSULATION

The standard insulation system is an advanced Class F rated system with superior electrical, thermal and mechanical characteristics for long life. The actual insulation life will be determined by operating conditions - temperature, contaminants in the atmosphere and mechanical forces including shock and vibration.

(Continued)

INSULATION (cont')

The accepted estimate for operating temperature on insulation life is that insulation life is reduced by one half for each 10-C rise in operating temperature when operated within its maximum allowable temperature; therefore, a motor operating at a lower temperature will have approximately twice the insulation life of a motor operating at 10° C higher.

Proper motor enclosure and a supply of clean cooling air will help extend insulation life for motors operating in areas with contaminates degrading to the insulation.

Careful attention to mounting and base design will reduce the possibility of insulation failure due to mechanical forces. Special insulation protection may be required for machines subjected to high cyclic overloads.

FIELD HEATING

In some applications of direct-current motors, the user may want to apply voltage to shunt field winding during periods when the motor is stationary and the armature circuit is not energized. The percent of rated shunt field voltage and the duration of standstill excitation which a direct current motor is capable of withstanding without excessive temperature will vary depending upon size, enclosure, rating and type of direct current motor.

Some direct-current motors are designed to be capable of continuous excitation of the shunt field at standstill with rated field voltage applied. Under this condition, the shunt field temperature may exceed rated temperature rise, and prolonged operation under this condition will result in reduced insulation life.

Reliance Electric DC motors have field heating capability as follows:

1. **Standard RPM III and SUPER RPM Motors for use with three-phase Controllers.**

Standard continuous duty DPG, TEFC and TENV Reliance DC motors have continuous duty fields capable of continuous excitation at standstill (armature circuit not energized) with normal insulation life when fields are excited at rated or 105% of rated field voltage. They will meet a safe temperature rise at 115% of rated field voltage, however, continuous operation at 115% of rated field voltage will result in reduced insulation life.

Standard continuous duty self-ventilated motors are suitable for rated load at rated speed operation at field voltages up to 110% of rated value. However, motor temperature will exceed the normal class F rise with resulting reduction in insulation life if operated below approximately 90% of base speed at rated voltage for prolonged periods. Refer to **Speed Range and Armature Voltage Control** in this section for allowable continuous current (torque) values below base speed without forced ventilation.

SUPER RPM Motors, frame size B500ATZ and larger, designed for forced ventilation as standard or with a dual-cooled heat exchanger (TEDC) must have cooling air when fields are excited at rated voltage. Installations having the air supply interrupted when the motor is not operating must have field disconnected or field voltage reduced to 50% rated.

RPM III Motors, frame sizes C180ATZ through C440ATZ, designed for forced ventilation as standard must have cooling air when fields are excited at rated voltage. Installations having the air supply interrupted when the motor is not operating must have field disconnected or field voltage reduced to 67% rated or motor insulation life will be significantly reduced.

With the blower motor running the DPFV motors will have normal insulation life with the fields excited at rated or 105% of rated field voltage with the armature not energized and will meet a safe temperature rise at 115% of rated field voltage. Continued operation at 115% of rated field will result in reduced insulation life.

2. **Stock Model Number Straight Shunt RPM III Motors for use with single-phase Controllers.**

These motors have continuous duty fields capable of continuous excitation at standstill (armature circuit not energized) under normal industrial conditions.

3. **Intermittent Duty DC Motors**

Motors rated 30 minute, 60 minute or other short time rating do not have fields capable of continuous excitation unless specifically requested on the sales order and indicated on the nameplate. Unless otherwise specified, all short time motors have fields capable of being excited only when the armature is energized.

MOTOR PROTECTION

The successful application of DC motors requires proper protection from the environment and from overtemperature and overcurrent operation. Refer to page M-323 (Enclosures) and the **Modification Section** for detailed information on the various types of enclosures to provide protection from the environment.

Several devices to indicate motor overtemperature are listed in the **Modification Section** along with their capabilities and limitations. The customer should select the proper device for the specific enclosure and application. Repeated operation of the overtemperature protector indicates a system installation which should be investigated.

Overcurrent sensing devices must be located remotely from the motor. These devices should be selected to match the thermal characteristics of the motor as closely as possible.

OVERLOADS

MOMENTARY - Standard RPM III and SUPER RPM motors are capable of operating with successful commutation for a period of one minute with a current load of 150 percent of rated at all speeds within the rated speed range. The overload may occur approximately four times per hour but motor rms load must never exceed the nameplate rating. In addition to this momentary overload rating, motors may be capable of additional overload rating depending on horsepower, base speed and field weakened speed.

(Continued)

OVERLOADS (cont')

Continual repetitive overloads will subject the armature and intercoil windings to high forces which may cause movement of the coils. This movement can break down the insulation on the coils. All applications requiring high overloads on a repetitive cyclic basis should be referred to Reliance Electric.

STARTING - Standard RPM III and SUPER RPM motors are capable of 250 percent full load current for starting duty occasionally repeated.

STABILIZED SHUNT FIELD DC MOTORS

Stabilized shunt wound motors have a high current, low turn winding connected in series with the motor armature carrying armature current. This series winding produces magnetic field flux in proportion to armature current, therefore, the total field flux increases as load current is increased tending to slow down or stabilize motor speed with increase in load.

With the series winding connected properly for forward rotation and motoring operation, it will be connected correctly under operating conditions of forward rotation with regenerative torque but the torque will be reduced. With reverse rotation and motoring torque the stabilizing effect of the series winding will be lost and the torque output of the motor will be reduced.

Motor having a stabilizing winding must have the series winding connected in the armature circuit to provide the proper speed stabilizing protection under overload conditions, and to obtain full rated torque from the motor. **If the series stabilizing winding is not connected, the control builder must insure that the motor is speed regulated to prevent the motor from exceeding the maximum safe speed listed on the motor nameplate.** Without the series winding connected, the motor will have reduced torque due to the loss of field flux from the series winding. Standard motor have typically 5 to 15% of the total field flux from the series winding at full load with rated excitation of the shunt field.

When considering the effect of the series field during regenerative operation, the designer must remember that the series field connected in the differential mode will result in at least twice the torque loss in regenerative operation compared to not having the series field connected as for motoring operation. The reversal of current through the series field causes the series field flux to oppose the main field flux resulting in this additional loss of torque.

In summary, the control manufacturer must insure that motor maximum safe speed is not exceeded and must recognize the resulting loss of torque when operating stabilized shunt wound motors without the series winding connected.

NOTE - *Reliance manufactures and stocks a broad range of stabilized and straight shunt motors. Straight shunt designs require that the motor be speed regulated.*

As indicated on the basic price pages, high horsepower motors in Frames B840AT thru B1600AT have straight shunt windings with pole-face compensating windings to provide inherent stability and essentially linear torque characteristics.

SPEED RANGE

Speed Range by Armature Voltage Control

DC motors have the inherent capability of producing rated torque when operated at rated current. However, the temperature rise of motors operated at full-load torque and at reduced armature voltage will vary with the enclosure, percentage of base speed and type of power supply. All self-ventilated motors (both drip-proof guarded and totally enclosed fan-cooled) suffer a loss of heat dissipating ability as the speed is reduced below base speed and this will require that the torque load be reduced to avoid overheating the motor. In addition, the armature current ripple of certain rectifier circuits increases as armature voltage is reduced providing increased armature heating. Therefore, allowable continuous torque capability below base speed is a function of both speed and power supply. The percent of rated continuous armature current allowed on Reliance Electric DPG enclosures is given in Figures 1 thru 3. Data is given for both rated Class F temperature rise which will give optimum motor insulation life and for maximum allowable temperature rise which will give reduced insulation life if operated for an appreciable part of motor operating time at low speed.

Standard self-ventilated RPM III and SUPER RPM motors may be operated at continuous full load currents down to approximately 60% of base speed on most power supplies. Standard DPG stock model number motors rated 180 volt armature for use on power supply K or 2/2-230-60-0 (S2R) are designed for full load current operation to 50% base speed.

The alternative to motor armature current derating for continuous reduced speed operation is the use of forced ventilation. Motor mounted blowers or separate forced ventilation for drip-proof guarded motors permit continuous full torque operation from base speed down to approximately one percent of base speed when the blower motors are operated on 60 Hz power. Refer to page M-332 (Power Supply - 50 Hz) for limitations when the blower motors are operated on 50 Hz power. TEAO motors C180-C400ATZ are constant torque to 5% of base speed.

TENV motors can generally be operated down to 5% base speed or lower on power supplies A, C and D since motor cooling is not dependent on motor speed except at lower armature rotation speeds the heat dissipation from the armature may be affected. When operated on high ripple power supplies such as power supply E some derating below 10% base speed may be required.

Standard TENV stock model numbers rated 180 volts armature for use on rectified power supply 2/2-230-60-0 (S2R) are designed for full load current operation to 1% base speed at maximum allowable temperature rise. When operated on power supply K they may be operated to 1% base speed with normal Class F temperature rise.

Calculated Data Show Approximate Values and Do Not Constitute Guarantees.

FIGURE 1 - Maximum continuous loads for self-ventilated motors in frame diameter C180ATZ Base Speed of 2500, 1750, 1150 and 850 rpm.

Figure 1-A: NORMAL CLASS F TEMP. RISE

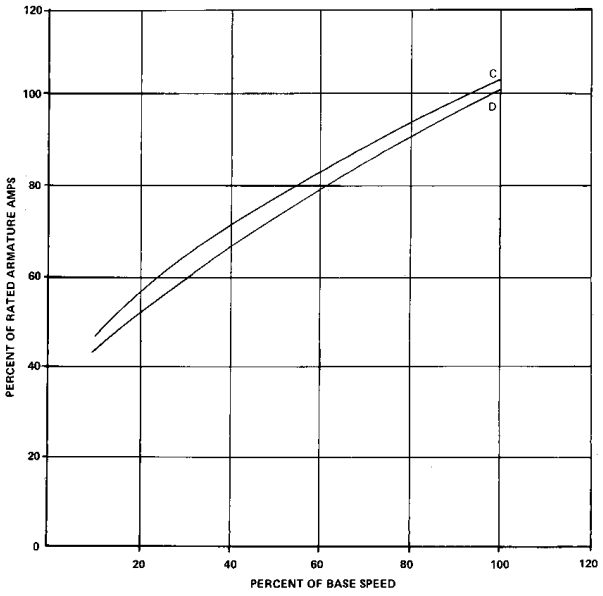
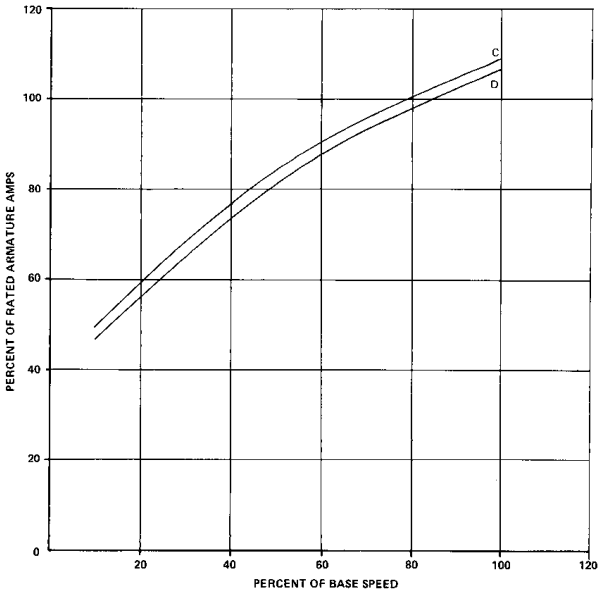


Figure 1-B: MAXIMUM ALLOWABLE TEMP. RISE



C. Operated from 3-phase, 60 Hertz, full-wave (6 controlled legs) AC RMS voltage - 230 volts for 240 V. motors and 460 volts for 500 V. motors. NEMA Power Supply-C.

D. Operated from 3-phase, 60 Hertz, full-wave (3 controlled legs) AC RMS voltage - 230 volts for 240 V. motors and 460 volts for 500 V. motors. NEMA Power Supply-D.

Calculated Data Show Approximate Values and Do Not Constitute Guarantees.

FIGURE 2 - Maximum continuous loads for self-ventilated motors in frame diameters C210ATZ-C360ATZ Base Speed of 2500, 1750, 1150 and 850 rpm.

Figure 2-A: NORMAL CLASS F TEMP. RISE

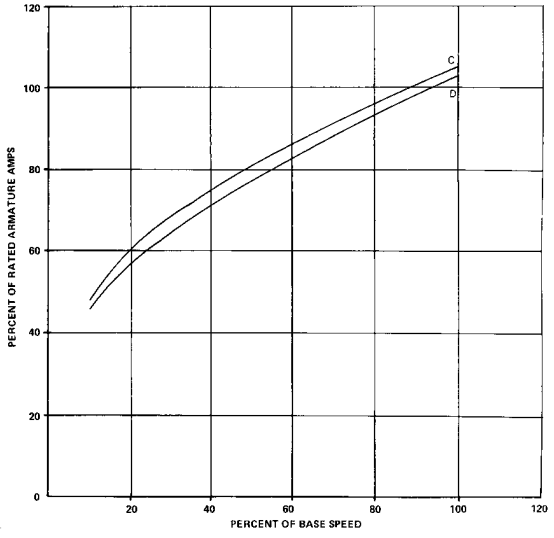
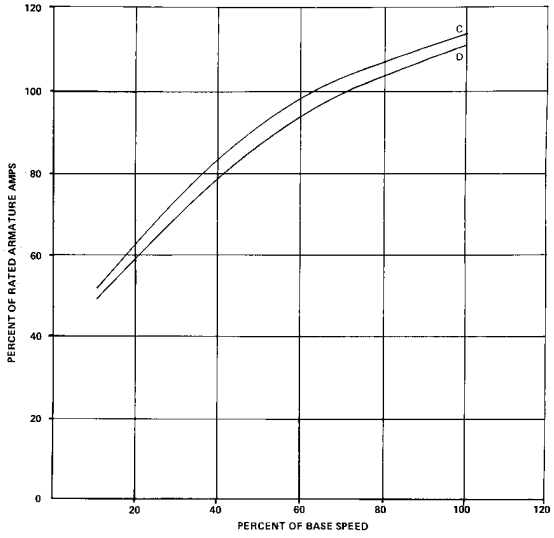


Figure 2-B: MAXIMUM ALLOWABLE TEMP. RISE



C. Operated from 3-phase, 60 Hertz, full-wave (6 controlled legs) AC RMS voltage - 230 volts for 240 V. motors and 460 volts for 500 V. motors. NEMA Power Supply-C.

D. Operated from 3-phase, 60 Hertz, full-wave (3 controlled legs) AC RMS voltage - 230 volts for 240 V. motors and 460 volts for 500 V. motors. NEMA Power Supply-D.

FIGURE 3 - Maximum continuous loads for self-ventilated motors in frame diameter C400ATZ Base Speed of 1750, 1150 and 850 rpm.

Figure 3-A: NORMAL CLASS F TEMP. RISE

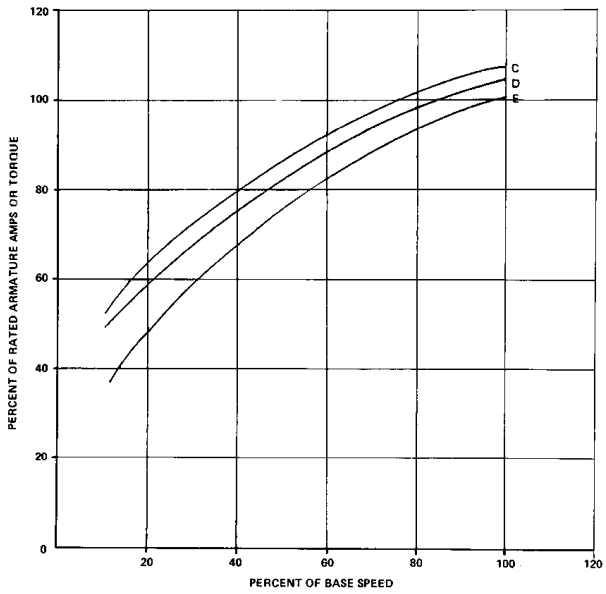
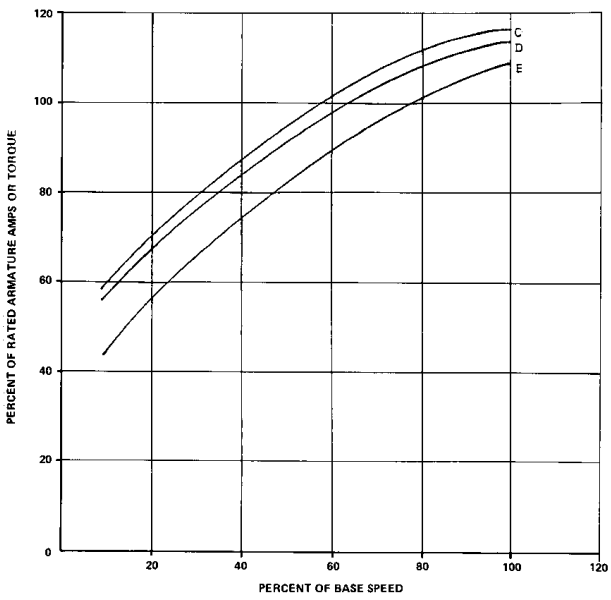


Figure 3-B: MAXIMUM ALLOWABLE TEMP. RISE



C. Operated from 3-phase, 60 Hertz, full-wave (6 controlled legs) AC RMS voltage - 230 volts for 240 V. motors and 460 volts for 500 V. motors. NEMA Power Supply-C.

D. Operated from 3-phase, 60 Hertz, full-wave (3 controlled legs) AC RMS voltage - 230 volts for 240 V. motors and 460 volts for 500 V. motors. NEMA Power Supply-D.

E. Operated from 3-phase, 60 Hertz, half-wave (3 controlled legs) grounded WYE secondary AC RMS voltage 480 V. line to line (278 V. line to Neutral) for 240 V. motors. NEMA Power Supply 3/3-480-60-0.

Speed Range by Field Control

DC motors may be operated in the field weakened range at rated armature voltage with a loss of output torque but with rated horsepower output. The amount of field weakening allowable is dependent on the rating and is specified in the Pricing Section and the **Modification Section. The motor control must be designed to limit the maximum motor speed under all operating conditions to the motor maximum safe speed listed on page M-326. Field weakened straight shunt motors must be regulated to limit speed to maximum safe speed. Compound wound motors are not suitable for operation over an extended speed range by shunt field weakening because of the very high no-load speeds that may result. Field weakening of 125% is the maximum allowable for compound wound motors.**

Whenever the motors are required for operation in the field range, the customer must specify the speed range and the motor nameplate must indicate the allowable field weakened speed.

STANDARDS - NEMA/IEC

Reliance Electric DC motors are designed and rated in accordance with National Electric Manufacturers Association (NEMA) standards which are acceptable in the United States and in many other countries. Users in some countries may specify motors to meet IEC (International Electrotechnical Commission) standards.

Ambient Conditions

Both NEMA and IEC standards base motor performance on a maximum ambient temperature of 40-C and a maximum altitude of 1000 meters or 3300 feet.

Variation Between Standards

IEC standards differ from NEMA standards mainly in frame designation, motor dimensions, and ratings. Other differences are definitions for enclosure, degree of protection, method of cooling, and short time rating. Also, the method of balance and values for power supply voltage and frequency vary between NEMA and IEC.

Frame Designation

The first two digits for the NEMA frame designation is four times the distance from the centerline of the shaft to the motor base or “d” dimension. For example, frame MC3212ATZ has a “d” dimension of 8.00 inches. IEC frame designation is equal to the shaft height (IEC “h” dimension) in millimeters. An IEC frame size 200 has a shaft height of 200 mm or 7.874 inches.

Dimensions

NEMA standard motor dimensions are in inches while IEC dimensions are in millimeters. The letter designations for various motor dimensions are also different between NEMA and IEC.

(Continued)

STANDARDS - NEMA/IEC (cont')

HP/KW

NEMA standards specify motors on the basis of horsepower (HP) and generators on the basis of kilowatts (kw). IEC rates both motors and generators on the basis of kilowatts. (1 HP =.746 kw)

Enclosures

Motor enclosures and degrees of protection are defined by NEMA in descriptive form; that is, drip-proof guarded, etc. (Refer to ENCLOSURES) IEC defines an "Index of Protection" (IP) consisting of a two digit number with the first digit indicating the degree of protection against entry of solid foreign bodies and the second number indicating the degree of protection against entry of liquids. For example, IP 23 - "2" - Guarded against solid bodies grater than 12 mm. "3" - Protected from spray coming from 0 to 60 degrees from the vertical.

Methods of Cooling

Method of cooling is defined by NEMA with descriptive phrases, i.e., "Non-ventilated" - no cooling by means external to the enclosure. IEC designates method of cooling by letter "IC" (index of cooling) followed by two digits with the first digit giving the cooling arrangement and the second digit indicating the method of power to circulate the coolant. For example, "IC 40" - "4" - frame surface (exterior) cooling. "0" - free convection. In NEMA designation this would be NV.

Although the terminology for both motor enclosures and method of cooling varies with NEMA and IEC, a correspondence between the two terminologies can be obtained for specific application conditions.

Time Rating

Short time rating tor motor operation is specified by NEMA as 5, 15, 30 or 60 minutes. This time rating indicates that the machine can provide rated output at rated speed for the given time period when the machine initial temperature is within 5-C of the ambient temperature. No reference is given to the "OFF" time required before the machine may again produce rated output. IEC specifies a TIME/DUTY rating indicated by the letter "S" followed by a single number (1 through 8) to indicate the intermittent periodic duty.

Balance

Balance limits are specified by NEMA in terms of maximum peak-to-peak displacement amplitude in inches. IEC defines balance limits in terms of maximum velocity (mm/sec.). Another major difference in balance procedure is that NEMA specifies balance to be done with a half key on the motor shaft while IEC specifies a full key be used.

Power Supply Type

Power supply type is defined by NEMA based on 60 Hz power to the rectifier and standard U.S. voltages. A letter code defines standard voltages and rectifier configurations. (See POWER SUPPLY) IEC power supplies are based on 50 Hz power and AC input voltages to the rectifier of 220, 380 or 500. The rectifier configuration is defined similar to NEMA but without the letter code.

Summary

Although many differences in specifications exist between NEMA and IEC, Reliance Electric can supply motors for those installations where IEC standards are specified. The degree of conformance to IEC standards needs to be clarified since many applications require that only a part of IEC standards must be met. For example, some installations require only conformance to special voltage and frequency. Specific requirements must be referred to Reliance Electric.

POWER SUPPLY

Power Supply Codes

Standard RPM III and SUPER RPM motors are specifically designed to operate on rectified power supplies. Due to the many different types of rectified power supplies, the following classification system has been adopted by NEMA.

Description	Code (1)
DC generator, battery or twelve pulse/cycle, six phase, full control	A
Six pulse/cycle, three-phase, full control 230 or 460 volt, 60 Hz input to rectifier	C
Three pulse/cycle, three-phase semi-bridge 1/2 control 230 or 460 volt, 60 Hz input to rectifier	D
Three pulse/cycle, three-phase, half wave (single way) 460 volt, 60 Hz input to rectifier	E
Two pulse/cycle, single phase, full wave (bridge circuit with 2-controlled rectifiers and 2-uncontrolled rectifiers and free-wheeling rectifier), 230 volt, 60 Hz input	K

(1) When the armature power supply cannot be designated by a single letter code (A, K, etc.) the power supply should be identified by the following code stamped on the motor nameplate. M/N F-V-H-L

where
- M = Total pulses per cycle
- N = Total controlled pulses per cycle
- F = Free wheeling (if used)
- V = Nominal line-to-line AC voltage to rectifier
- H = Line Frequency - Hz
- L = Value series inductance (in millihenries) to be added externally to the motor armature circuit

Example:

A. "6/3 F-380-50-12" defines a power supply having 6 total pulses per cycle, 3 controlled pulses per cycle (S-3), with free wheeling, 380 volts, 50 Hz AC input to bridge, and a 12 millihenry choke to be added externally to the motor armature circuit.

Standard RPM III and SUPER RPM motors are designed to operate on the power supply indicated in the **Pricing Section**. Motors designed to operate on power code E or Reliance S3R are available by making a price addition from the Modification Section. Motors for use on other power supplies should be referred to Reliance Electric.

(Continued)

POWER SUPPLY (cont')

All motors will have the NEMA power supply code stamped on the nameplate.

Since the code letter has been selected in alphabetical order of increasing magnitude of ripple current, a motor may be operated on a power supply having a letter designation prior in the alphabet to the letter stamped on the nameplate, with no loss in nameplate rating. For example, a motor designed for a D type of power supply may be used on a C power supply having the same voltage rating.

Operating a motor on a power supply having a letter designation later in the alphabet to the letter stamped on the nameplate - for example, operating a power code C motor on a power code D supply will require derating the motor horsepower. The required derating for motors operated in the voltage range may be estimated from the curves on pages M-329 **(Speed Range by Armature Voltage Control)**.

Power Supply - 50 Hz

The standard NEMA power supply codes designate 60 Hz input to the rectifier bridge. When operated on 50 Hz rectified supplies, the motor may have to be derated for the following reasons.

1. The 50 Hz power source increases the ripple current due to the lower armature circuit reactance resulting in increased motor heating and possible commutation problems.
2. The cooling air for forced ventilation, air-over and dual-cooled motors with AC motor driven blowers is reduced considerably by the lower AC motor speed on 50 Hz power.

Motors operated on 50 Hz rectified power supplies must be identified as suitable for 50 Hz operation or be checked for possible derating on 50 Hz power.

BELTED APPLICATIONS

All V-Belt drives must be designed and applied in accordance with the recommendations in this section.

To avoid excessive bearing loads and shaft stresses, belts should not be tightened more than necessary to transmit the rated torque. The pre-tensioning of the V-belt drive should be based on the total tightening force required to transmit the horsepower divided by the number of belts. This procedure avoids the excessive load caused by tightening individual belts to a prescribed level recommended by belt manufacturers.

Shaft stresses and bearing and belt loads will be reduced if sheave diameters larger than the calculated minimum are used, but the number of belts should be reduced accordingly.

The maximum V-belt velocity is 6500 feet per minute at highest motor operating speed.

Mounting

In general, the closer pulleys, sheaves, sprockets or gears are mounted to the bearing on the motor shaft, the less will be the load on the bearing. This will give greater assurance of trouble free service.

The center point of the belt, or system of V-belts, must not be beyond the end of the motor shaft.

The inner edge of the sheave or pulley rim should not be closer to the bearing than the shoulder on the shaft but should be as close to this point as possible.

The outer edge of a chain sprocket or gear must not extend beyond the end of the motor shaft.

Minimum V-Belt Sheave Diameters

The calculated minimum pitch of the V-belt sheave is based on the following:

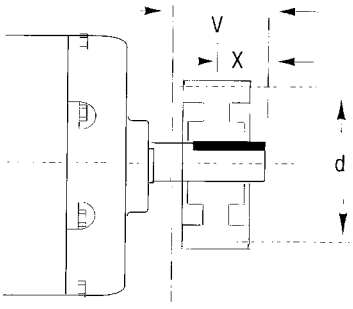
1. Belt service factor of approximately 1.6 with belts tightened to the belt manufacturer's recommendations.
2. Speed reduction not exceeding 5:1.
3. Mounting of sheave on motor shaft in accordance with the preceding Mounting recommendations.
4. Center-to-center distance between sheaves approximately equal to five times the pitch diameter of the smaller sheave.

NOTE - *The value "d" calculated may indicate a minimum sheave diameter which is smaller than is practicable to assemble on the motor shaft extension.*

The horsepower ratings for belt drives may be found in ANSI Standard B5512 or in "Specifications for Drives Using Narrow Multiple V-Belts (3V, 5V and 8V Cross Sections)" published by Rubber Manufacturers Association and Mechanical Power Transmission Association or in Dodge PT Components Engineering Catalog.

Preferred V-Belt Drives - Sheave Centerline is Toward Motor From End of Shaft.

Minimum pitch diameters of sheaves must not be smaller than the values calculated by the following formula where the sheave centerline is toward the motor from the end of the shaft.



$$d \text{ inches} = \frac{hp}{100} (A - Bx):$$

where:

d = minimum pitch diameter of V-belt sheave in inches.

hp = rated horsepower at base speed

x = axial distance of the sheave centerline from the end of the shaft in inches. The distance is measured from the end of the shaft (x is negative if centerline is beyond the end of the shaft and positive if toward the motor). The formula should not be used for negative values of x greater than one half of the V dimension of the shaft extension.

A, B = Constants from Table III corresponding to the base speed of the motor.

Minimum Pitch Diameter For Drives Other Than V-Belt

To obtain the minimum pitch diameters for flat belt, timing-belt, chain and gear drives, apply the multiplier given in Table II to the minimum sheave diameter calculated for V-belt drives.

The maximum V-belt velocity is 6500 feet per minute at highest motor operating speed.

TABLE II - Multipliers For Drives Other Than V-Belt

Drive	Multiplier
Flat Belt (See Note 1)	1.33
Timing Belt (See Note 2)	0.90
Chain Sprocket	0.70
Spur Gear	0.75
Helical Gear	0.85

NOTE 1: The above multiplier is intended for use with conventional single-ply flat belts. When other than single-ply flat belts are used, the use of a larger multiplier is recommended

NOTE 2: It is often necessary to install belts with a snug fit. However, tension should be no more than that necessary to avoid belt slap or tooth jumping.

TABLE III - Constants For Calculating The Minimum Sheave Diameters For V-Belt Drives

Frame		"V" Dim.	Constant	Base rpm							
				300	400	500	650	850	1150	1750	2500
C180ATZ(1)	inches	2.5	A	-	-	-	-	60.47	49.8	38	30.27
			B	-	-	-	-	2.52	2.08	1.6	1.28
C210ATZ	inches	3.5	A	-	-	-	-	40.6	30	19.77	14.63
			B	-	-	-	-	7.26	5.43	3.56	2.09
C250ATZ	inches	4	A	-	-	-	-	23.33	18.25	12.67	9.47
			B	-	-	-	-	3.58	2.3	1.17	0.57
UC280ATZ	inches	4.5	A	-	-	-	-	20.28	16.17	11.2	8.32
			B	-	-	-	-	2.94	1.75	0.84	0.43
UC320ATZ	inches	5	A	-	-	-	-	18.47	14.25	9.97	-
			B	-	-	-	-	2	1.24	0.59	-
UC360ATZ	inches	6.25	A	-	-	-	-	10.42	8.08	5.89	-
			B	-	-	-	-	0.46	0.25	0.13	-
UC400ATZ	inches	8	A	20.1	16.1	13.5	11	8.9	6.9	4.8	-
			B	0.68	0.54	0.46	0.37	0.3	0.23	0.16	-
UC440ATZ	inches	8	A	20.1	16.1	13.5	11	8.9	6.9	4.8	-
			B	0.68	0.54	0.46	0.37	0.3	0.23	0.16	-
UC500ATZ	inches	8	A	20.1	16.1	13.5	11	8.9	-	-	-
			B	0.74	0.59	0.49	0.4	0.33	-	-	-
UB500ATZ	inches	8	A	20.1	16.1	13.5	11	8.9	-	-	-
			B	0.68	0.54	0.46	0.37	0.3	-	-	-
UB580ATZ	inches	8	A	20.1	16.1	13.5	11	8.9	-	-	-
			B	0.74	0.59	0.49	0.4	0.33	-	-	-
B680ATZ	inches	8.75	A	Non-standard - Consult Reliance Electric							
			B								

(1) Refer to I/M C-3080 for DC180ATZ frame

(2) Refer to Reliance Electric for UC440ATZ frame

ENGINEERING ESTIMATING DATA

Bearing and Shaft Data

Frame	Opposite End Drive			Drive End			Remarks
	Standard "FU"	Max"FU" (1)	Bearing	Standard "U" (1)	Max"U" (1)	Bearing	
C180ATZ	1.125	1.125	206	1.375	1.500	208	Coupled Or Belted Drive
C210ATZ	1.625	1.750	209	1.875	1.875	310	Coupled Or Belted Drive
C2512ATZ	1.875	1.938	210	2.125	2.500	313	Coupled Or Belted Drive
C2514ATZ	1.875	1.938	210	2.375	2.500	313	Coupled Or Belted Drive
C2515ATZ	1.875	1.938	210	2.375	2.500	313	Coupled Or Belted Drive
C2812ATZ	2.125	2.125	211	2.375	2.938	215	Coupled Duty Only
UC2812ATZ	2.125	2.125	211	2.625	2.938	NU215	Belted Duty Only
C2813ATZ	2.125	2.125	211	2.375	2.938	215	Coupled Duty Only
UC2813ATZ	2.125	2.125	211	2.625	2.938	NU215	Belted Duty Only
C2815ATZ	2.125	2.125	211	2.375	2.938	215	Coupled Duty Only
UC2815ATZ	2.125	2.125	211	2.625	2.938	NU215	Belted Duty Only
C3212ATZ	2.250	2.500	213	2.625	3.312	217	Coupled Duty Only
UC3212ATZ	2.250	2.500	213	2.875	3.312	NU217	Belted Duty Only
C3214ATZ	2.250	2.500	213	2.625	3.312	217	Coupled Duty Only
UC3214ATZ	2.250	2.500	213	2.875	3.312	NU217	Belted Duty Only
C360ATZ	2.875	3.125	216	2.875	3.625	219	Coupled Duty Only
UC360ATZ	2.875	3.125	216	3.250	3.625	NU219	Belted Duty Only
C400ATZ	3.625	3.625	219	3.625	3.625	219	Coupled Duty Only
UC400ATZ	3.625	3.625	219	4.125	4.125	NU222	Belted Duty Only
C440ATZ	3.625	3.625	219	3.625	4.125	222	Coupled Duty Only
UC440ATZ	3.625	3.625	219	4.125	4.125	NU222	Belted Duty Only
C500ATZ	4.125	4.125	222	4.500	4.500	224	Coupled Duty Only
UC500ATZ	4.125	4.125	222	4.500	4.500	NU224	Belted Duty Only
B500ATZ	3.625	-	219	3.625	3.625	219	Coupled Duty Only
UB500ATZ	3.625	-	219	4.125	4.125	NU222	Belted Duty Only
B580ATZ	4.125	-	222	4.125	4.125	333	Coupled Duty Only
UB580ATZ	4.125	-	222	4.125	4.125	NU222	Belted Duty Only
B680ATZ	4.500	-	224	4.500	-	224	Coupled Duty Only
B840AT	5.750	-	230	5.750	-	230	Coupled Duty Only
B840ATZ	5.750	-	230	6.500	-	234	Tandem Drive-Coupled Duty Only
B962AT-B966AT	6.500	-	234	6.500	-	234	Coupled Duty Only
B962AT-B966ATZ	6.500	-	234	7.250	-	238	Tandem Drive-Coupled Duty Only
B967AT-B969AT	7.25	-	238	7.75	-	240	Coupled Duty Only

(1) Maximum "U" dimension is largest diameter that can be supplied with standard bearing. Price addition must be made to obtain this maximum diameter or any diameter between the standard and the maximum. Contact Product Marketing for maximum "FU" on TEFC enclosure.

ENGINEERING ESTIMATING DATA
Bearing and Shaft Data (Continued)

AFBMA Designation Versus Bearing Size

Ball Bearings - Single Row, Ball-Deep Groove, Open (No Shields)
Std. Cage, ABEC 1, AFBMA 3 Clearance, SLUSH.

Size	AFBMA Designation	Size	AFBMA Designation
206	30BC02J30X	222	110BC02J30X
208	40BC02J30X	224	120BC02J30X
209	45BC02J30X	230	150BC02J30X
210	50BC02J30X	234	170BC02J30X
211	55BC02J30X	238	190BC02J30X
213	65BC02J30X	240	200BC02J30X
215	75BC02J30X	310	50BC03J30X
216	80BC02J30X	313	65BC03J30X
217	85BC02J30X	314	70BC03J30X
219	95BC02J30X		

Roller Bearings - Single Row, Cylindrical Roller, ABEC 1, AFBMA 3 Clearance, SLUSH, Heat Stabilized.

Size	AFBMA Designation
NU215	75RU02M30X
NU217	85RU02M30X
NU219	95RU02M30X
NU222	110RU02M30X
NU238	190RU02M30X
NU244	220RU02M30X
NU248	240RU02M30X
NU252	260RU02M30X
NU1056	280RU02M30X
NU1064	320RU02M30X

Slide Bases and Rails

Frame	Part No.	Dim. Sheet	Type
DC189ATZ	42384-26BZ	609987-501	Heavy Duty Adjustable Slide Base (2)
DC1810ATZ	42384-74B	609987-501	
DC1811ATZ	42384-26BE	609987-501	
C1811ATZ	42384-26BE	609987-1	
C1812ATZ	42384-26BF	609987-1	
DC2112ATZ	42384-26BH	609958-51	
C2113ATZ	419914-1A	609957-1	
C2115ATZ	419914-1P	609957-1	
C2512ATZ	419914-1B	609957-1	
C2514ATZ	419914-1R	609957-1	
C2515ATZ	419914-1S	609957-1	
UC2812ATZ	419914-1C	609957-1	
UC2813ATZ	419914-1T	609957-1	
UC2815ATZ	419914-1U	609957-1	
UC3212ATZ	419914-1D	609977-1	
UC3214ATZ	419914-1W	609977-1	
UC3612ATZ	419914-1E	609977-1	
UC3613ATZ	419914-1X	609977-1	
UC4011ATZ	419914-8A	609977-4	
UC4013ATZ	419914-8B	609977-4	
UC4412ATZ	419914-8D	609977-4	
UC4413ATZ	419914-8E	609977-4	
UC4414ATZ	419914-8F	609977-4	
UC500ATZ	42384-5-D	609907-2	Adjustable Slide Rails (2 per set)
UB500ATZ	42384-5-D	609907-2	
UB580ATZ	42384-5-H	609907-2	
UB680ATZ(3)	42384-5-G	609907-2	

(2) Heavy duty adjustable slide bases have two adjusting bolts.

(3) Frames B680ATZ available for belted duty cannot be priced from this catalog. Refer details of application to Reliance Electric for special quotation.

ENGINEERING ESTIMATING DATA

Blower Motor Data

AC Motor Specifications For Blower Motors On Standard Drip-proof Forced-Ventilated DC Motors (1) (2)

DC Motor		Blower Motor 60 Hz							
			3-Phase, 60 Hz, 240/480 V			3-Phase, 50 Hz, 240/480 V (6)			
Frame	Speed rpm	HP	rpm	F.L. Amps	Locked Rotor Amps	rpm	F.L. Amps	Locked Rotor Amps	Part Number
C180ATZ	All	1/3	3450	1.3/.65	6.6/3.3	2850	1.5/.75	7/3.5	610490-1-B
C2113ATZ	All	3/4	3450	2.6/1.3	18/9	2850	2.4/1.2	20.6/10.3	610490-1-AH
C2115ATZ	All	3/4	3450	2.6/1.3	18/9	2850	2.4/1.2	20.6/10.3	610490-1-AH
C2512ATZ	All	3/4	3450	2.6/1.3	18/9	2850	2.4/1.2	20.6/10.3	610490-1-AH
C2514ATZ	All	3/4	3450	2.6/1.3	18/9	2850	2.4/1.2	20.6/10.3	610490-1-AH
C2515ATZ	All	3/4	3450	2.6/1.3	18/9	2850	2.4/1.2	20.6/10.3	610490-1-AH
C2812ATZ	All	1-1/2	3450	3.5/1.75	36/18	2850	3.9/2	43/22	610490-1-AF
C2813ATZ	All	1-1/2	3450	3.5/1.75	36/18	2850	3.9/2	43/22	610490-1-AF
C2815ATZ	All	1-1/2	3450	3.5/1.75	36/18	2850	3.9/2	43/22	610490-1-AF
C3210ATZ	All	2	3450	5.2/2.6	49/24.5	2850	6.2/3.1	52/26	610490-1-DG
C3212ATZ (8)	All	2	3450	5.2/2.6	49/24.5	2850	6.2/3.1	52/26	610490-1-DG
C3214ATZ	All	2	3450	5.2/2.6	49/24.5	2850	6.2/3.1	52/26	610490-1-DG
C3612ATZ (9)	All	1-1/2	3450	3.5/1.75	36/18	2850	3.9/2	43/22	610490-1-AF
C3613ATZ 60 Hz	All	3	3450	7.6/3.8	57/28.5	-	-	-	610490-1-BW
C3613ATZ 50 Hz	All	2-1/2	-	-	-	2850	7.0/3.5	60/30	610490-1-BX
C400ATZ 60 Hz	All	3	3450	7.6/3.8	57/28.5	-	-	-	610490-1BW
C400ATZ 50 Hz	All	2-1/2	-	-	-	2850	7.01/3.5	60/30	610490-1BX
C440ATZ	All	5	3450	6-Dec	29.2/14.6	-	-	-	610490-3F
C500ATZ	All	7.5	3600 (5)	18.4/9.2	128/64	-	-	-	406122-5AAG
B506ATZ thru B5010ATZ	All	2	1730 (5)	5.9/2.95 (5)	34.0/17.0 (5)	1450 (5)	7.0/3.5(5)	39.0/19.5(5)	406122-5KR
B587ATZ thru B589ATZ	All	2	1730 (5)	5.9/2.95 (5)	34.0/17.0 (5)	1450 (5)	7.0/3.5(5)	39.0/19.5(5)	406122-5KR
BB5810ATZ	All	5	1740 (5)	14.2/7.1 (5)	84/42 (5)	-	-	-	406122-5KT
B685ATZ	All	5	1740 (5)	14.2/7.1 (5)	84/42 (5)	-	-	-	406122-5KT
B686ATZ thru B688ATZ	All	2	1730 (5)	5.9/2.95(5)	34.0/17.0 (5)	1450 (5)	7.0/3.5(5)	39.0/19.5(5)	406122-5KR
B689ATZ	All	5	1740 (5)	14.2/7.1 (5)	84/42 (5)	-	-	-	406122-5KT
B840AT	All	5 (3)	1740 (5)	14.2/7.1 (5)	84/42(5)	-	-	-	406122-5KT
B840AT	All	10 (3)	-	-	-	2920 (4)	26/15(4)	142/83(4)	406122-5KC
B960AT	All	5 (3)	1740 (5)	14.2/7.1 (5)	84/42(5)	-	-	-	406122-5KT
B960AT	All	10 (3)	-	-	-	2920(4)	26/15(4)	142/83(4)	06122-5KC
B1200AT	All	7.5 (3)	1750 (5)	21.0/10.5 (5)	119.2/59.6 (5)	-	-	-	406122-5MA
B1400AT	All	7.5 (3)	1750 (5)	21.0/10.5 (5)	119.2/59.6 (5)	-	-	-	406122-5MA
B1600AT	All	10 (3)	1750 (5)	27.0/13. 5(5)	160/80 (5)	-	-	-	406122-5MB

AC Motor Specifications For Blower Motors On Standard Totally Enclosed Air-Over In-Line DC Motors (1)

DC Motor		Blower Motor 60 Hz							
		3-Phase, 60 Hz, 240/480 V				3-Phase, 50 Hz, 240/480 V (6)			
Frame	Speed rpm	HP	rpm	F.L. Amps	Locked Rotor Amps	rpm	F.L. Amps	Locked Rotor Amps	Part No.
C180ATZ	All	3/4	1725	2.4/1.2	19.4/9.7	1425	2.6/1.3	18.5/9.25	610490-1-CD
C210ATZ	All	3/4	1725	2.4/1.2	19.4/9.7	1425	2.6/1.3	18.5/9.25	610490-1-CD
C250ATZ	All	3/4	1725	2.4/1.2	19.4/9.7	1425	2.6/1.3	18.5/9.25	610490-1-CD
C280ATZ	All	3/4	1725	2.4/1.2	19.4/9.7	1425	2.6/1.3	18.5/9.25	610490-1-CD
C320ATZ	All	3/4	1725	2.4/1.2	19.4/9.7	1425	2.6/1.3	18.5/9.25	610490-1-CD
C360ATZ	All	1-1/2	1725	4.8/2.4	27.6/13.8	1425	5.2/2.6	30.4/15.2	610490-1-F
C400ATZ	All	3	1725	8.3/4.15	55/27.5	1425	9/4.5	62/31	610490-1AD

AC Motor Specifications For Blower Motors On Standard Totally Enclosed Air-Over Piggy-Back DC Motors (1)

DC Motor		Blower Motor 60 Hz							
		3-Phase, 60 Hz, 240/480 V				3-Phase, 50 Hz, 240/480 V (6)			
Frame	Speed rpm	HP	rpm	F.L. Amps	Locked Rotor Amps	rpm	F.L. Amps	Locked Rotor Amps	Part No.
C180ATZ	All	1/3	3450	1.3/.65	18.6/9.3	2580	1.5/.75	7.0/3.5	610490-1-B
C210ATZ	All	3/4	3450	2.6/1.3	18.6/9.3	2850	2.4/1.2	20.6/10.3	610490-1-AH
C250ATZ	All	3/4	3450	2.6/1.3	18.6/9.3	2850	2.4/1.2	20.6/10.3	610490-1-AH
C280ATZ		3/4	3450	2.6/1.3	18.6/9.3	2850	2.4/1.2	20.6/10.3	610490-1-AH
C320ATZ	All	3/4	3450	2.6/1.3	18.6/9.3	2850	2.4/1.2	20.6/10.3	610490-1-AH
C360ATZ	All	1-1/2	3450	3.5/1.75	36/18	2850	3.9/1.95	43.2/21.6	610490-1-AF
C400ATZ	All	1-1/2	3450	3.5/1.75	36/18	2850	3.9/1.95	43.2/21.6	610490-1-AF
B500ATZ	All	1	1730 (5)	3.4/1.7 (5)	6.0/13.0 (5)	1440	4.2/2.1	28.6/14.3	406122-5KS

AC Motor Specifications For Blower Motors On Standard Totally Enclosed Dual-Cooled DC Motors With Air-to-Water Heat Exchangers (1)

DC Motor		Blower Motor 60 Hz					
		3-Phase, 60 Hz, 240/480 V					
Frame	Speed rpm	HP	rpm	F.L. Amps	Locked Rotor Amps	Part No.	Frame
B580ATZ	All	5	1750	4.2/7.1	84/42	406122-5KT	184TC
B680ATZ	All	3	1745	9.2/4.6	58/29	406122-5-LH	182TC
B840AT	All	5 (3)	1740	14.2/7.1	84/42	406122-5-KT	184TC
B960AT	All	5 (3)	1740	14.2/7.1	84/42	406122-5-KT	184TC
B1200AT	All	7.5 (3)	1800	21/10.5	119.2/59.6	406122-5-MA	213TC
B1400AT	All	7.5 (3)	1800	21/10.5	119.2/59.6	406122-5-MA	213TC
B1600AT	All	10 (3)	1800	27/13.5	160/80	406122-5-MB	215TC

(1) For estimating purposes only
(2) See next page for Filter Data.
(3) Two blower motors of this HP rating on each DC motor
(4) 220/380 volts
(5) 230/460 volts
(6) Consult Reliance Electric for de-rated Hz operation
(8) Definite purpose Extruder Duty design has three-phase blower motor rated 1-1/2 HP, 3450/2850 RPM, 240/480 volts, 60/50 HZ - PART NO. 610490-1AF
(9) Definite purpose Extruder Duty design has three-phase blower motor rated 3 HP, 3450/2850 RPM, 240/480 volts, 60/50 Hz - part no. 610490-1BW

ENGINEERING ESTIMATING DATA

Inertia and Weight

Frame Size	Wk2-LbFt2(1)		Motor Weight - Lbs(1)			
	Forced Vent Without Internal Fan	Self Vent With Internal Fan	Self Vent	Forced Vent	Forced Vent With Blower	Pipe-In Separately
DC189ATZ	0.620	0.62	110	135	150	110
DC1810ATZ	0.680	0.68	120	145	160	120
C1811ATZ	0.683	0.683	160	185	200	155
DC1811ATZ	0.791	0.791	130	155	170	130
C1812ATZ	0.787	0.787	180	205	220	175
DC2112ATZ	2.090	2.09	280	-	-	-
SC2113ATZ	2.33	2.33	315	340	345	315
MC2113ATZ	2.56	2.56	340	365	370	340
LC2113ATZ	2.87	2.87	370	395	400	370
MC2115ATZ	3.10	3.10	395	420	425	395
LC2115ATZ	3.62	3.62	450	474	480	450
SC2512ATZ	4.83	4.83	505	530	535	505
MC2512ATZ	5.51	5.51	540	565	570	540
LC2512ATZ	6.18	6.18	580	605	610	580
C2514ATZ	7.64	7.64	665	690	695	665
C2515ATZ	9.43	9.43	775	800	805	775
MC2812ATZ	8.47	8.47	775	805	810	775
LC2812ATZ	10.00	10.00	850	880	885	850
C2813ATZ	11.15	11.15	905	935	940	905
C2815ATZ	14.97	14.97	1,090	1,120	1,125	1,090
SC3210ATZ	13.46	13.46	1,080	1,110	1,115	1,080
MC3212ATZ	17.10	17.10	1,175	1,205	1,210	1,175
LC3212ATZ	19.50	19.50	1,255	1,285	1,290	1,255
C3214ATZ	25.51	25.51	1,435	1,465	1,470	1,435
MC3612ATZ	38.69	38.69	1,650	1,680	1,685	1,650
LC3612ATZ	46.61	46.61	1,815	1,845	1,850	1,815
C3613ATZ	54.00	54.00	1,975	2,000	2,010	1,975
C4011ATZ	66.20	68.20	2,425	2,490	2,500	2,400
MC4013ATZ	81.50	83.50	2,725	2,790	2,800	2,700
LC4013ATZ	92.06	94.06	3,065	3,100	3,100	3,065
C4412ATZ	123.20	-	-	3,245	3,245	3,045
C4413ATZ	144.60	-	-	3,660	3,660	3,460
C4414ATZ	178.00	-	-	4,280	4,280	4,080
C5010ATZ	215.40	-	-	3635	3635	3410
C5011ATZ	249.00	-	-	4195	4195	3790
C5012ATZ	282.50	-	-	4760	4760	4535
C5013ATZ	324.50	-	-	5465	5465	5240
B506ATZ	108	131	2,600	2,625	2,705	2,560
B507ATZ	126	149	3,030	3,025	3,135	2,990
B508ATZ	144	167	3,425	3,450	3,585	3,385
B509ATZ	174	197	-	-	3,865	3,650
B5010ATZ	202	225	-	-	4,225	4,050
B587ATZ	282	317	4,555	4,570	4,670	4,505
B588ATZ	319	354	5,140	5,155	5,255	5,090
BB588ATZ	333	368	-	-	-	-
B589ATZ	350	385	5,540	5,555	5,655	5,490
BB589ATZ	365	400	-	-	-	-
BB5810ATZ	398	433	-	-	-	6,000

Frame Size	Wk2-LbFt2(1)		Motor Weight - Lbs(1)			
	Forced Vent Without Internal Fan	Self Vent With Internal Fan	Self Vent	Forced Vent	Forced Vent With Blower	Pipe-In Separately
B686ATZ	578	631	6,880	6,885	6,985	6,820
B687ATZ	633	686	7,550	7,555	7,655	7,490
B688ATZ	731	784	8,710	8,715	8,815	8,650
B689ATZ	819	872	-	-	-	9,400
B842ATZ	1,044	-	-	10,960	11,160	10,635
B843ATZ	1,144	-	-	11,895	12,095	11,570
B844ATZ	1,224	-	-	12,705	12,905	12,380
B845ATZ	1,365	-	-	13,940	14,140	13,615
B846ATZ	1,465	-	-	15,045	15,245	14,720
B847ATZ	1,565	-	-	15,900	16,100	15,575
B962ATZ	2,468	-	-	15,965	16,165	15,640
B963ATZ	2,668	-	-	17,050	17,250	16,725
B964ATZ	2,908	-	-	18,510	18,710	18,185
B965ATZ	3,227	-	-	20,215	20,415	19,890
B966ATZ	3,547	-	-	22,100	22,300	21,775
B967AT	6,916	-	-	-	23,700	23,175
B968AT	5,254	-	-	-	24,990	24,465
B969AT	4,676	-	-	-	26,440	25,915
B1202AT	4,330	-	-	-	22,900	21,400
B1204AT	5,080	-	-	-	25,300	23,800
B1205AT	5,630	-	-	-	27,100	25,600
B1206AT	6,070	-	-	-	28,600	27,100
B1207AT	6,530	-	-	-	30,100	28,600
B1208AT	7,190	-	-	-	31,800	30,300
B1209AT	7,640	-	-	-	33,200	31,700
B1401AT	5,880	-	-	-	24,000	22,500
B1403AT	6,990	-	-	-	26,500	25,000
B1405AT	8,620	-	-	-	29,800	28,300
B1406AT	9,450	-	-	-	30,500	29,000
B1407AT	10,140	-	-	-	32,900	31,400
B1408AT	10,530	-	-	-	33,900	32,400
B1409AT	11,820	-	-	-	36,400	34,900
B1601AT	12,790	-	-	-	34,600	33,000
B1602AT	15,040	-	-	-	37,860	36,260
B1603AT	17,580	-	-	-	41,470	39,870
B1604AT	19,830	-	-	-	44,650	43,050
B1605AT	21,610	-	-	-	47,180	45,580
B1606AT	22,820	-	-	-	48,890	47,290
B1607AT	24,320	-	-	-	51,000	49,400
B1608AT	25,500	-	-	-	52,700	51,100
B1609AT	27,900	-	-	-	56,100	54,500
B1610AT	30,300	-	-	-	59,570	57,970

(1) For estimating purposes only.

Approximate full load current (Average DC values) for estimating purpose only

HP	Amps at 180 V	Amps at 240 V	Amps at 500 V	Amps at 600 V	Amps at 700 V
1	6.1	4.7	-	N/A	N/A
1-1/2	8.3	6.6	-	N/A	N/A
2	9.6	8.5	-	N/A	N/A
3	14.1	12.2	-	N/A	N/A
5	24.0	20.0	10	N/A	N/A
7-1/2	36	28	14	N/A	N/A
10	N/A	37	17	N/A	N/A
15	N/A	54	26	N/A	N/A
20	N/A	71	34	N/A	N/A
25	N/A	88	42	N/A	N/A
30	N/A	105	50	N/A	N/A
40	N/A	141	68	N/A	N/A
50	N/A	175	84	N/A	N/A
60	N/A	212	99	N/A	N/A
75	N/A	255	123	N/A	N/A
100	N/A	341	164	N/A	N/A
125	N/A	425	205	N/A	N/A
150	N/A	508	245	N/A	N/A
200	N/A	675	325	N/A	N/A
250	N/A	840	405	N/A	N/A
300	N/A	N/A	477	N/A	N/A
400	N/A	N/A	633	N/A	N/A
500	N/A	N/A	793	N/A	N/A
600	N/A	N/A	950	N/A	N/A
700	N/A	N/A	1,100	N/A	N/A
800	N/A	N/A	1,262	N/A	N/A
900	N/A	N/A	1,430	N/A	N/A
1000	N/A	N/A	1,585	N/A	N/A
1100	N/A	N/A	1,747	1,455	N/A
1250	N/A	N/A	N/A	1,642	1,412
1500	N/A	N/A	N/A	1,963	1,704
1750	N/A	N/A	N/A	N/A	1,960
2000	N/A	N/A	N/A	N/A	2,234
2250	N/A	N/A	N/A	N/A	2,528
2500	N/A	N/A	N/A	N/A	2,812
3000	N/A	N/A	N/A	N/A	3,359

Filter data for DC motors with motor-mounted blower with filter

Frame	Quantity	Size - Inches	Type
C180ATZ	1	6.81 Dia. X 6.12 Long	Washable Wire Mesh Fiberglass Replaceable
C2113ATZ	1	9.12 Dia. X 6.12 Long	
C2115ATZ	1	9.12 Dia. X 9.62 Long	
C2512ATZ	1	9.12 Dia. X 6.12 Long	
C2514ATZ	1	9.12 Dia. X 9.62 Long	
C2515ATZ	1	9.12 Dia. X 9.62 Long	
C2812ATZ	1	9.12 Dia. X 9.62 Long	
C2813ATZ	1	10.88 Dia. X 9.62 Long	
C2815ATZ	1	10.88 Dia. X 9.62 Long	
C3210ATZ	1	9.12 Dia. X 9.62 Long	
C3212ATZ	1	9.12 Dia. X 9.62 Long	
C3214ATZ	1	10.88 Dia. X 9.62 Long	
C3612ATZ	1	10.88 Dia. X 9.62 Long	
C3613ATZ	1	10.88 Dia. X 12.00 Long	
C400ATZ	1	10.88 Dia. X 12.00 Long	
C440ATZ	1	1.00 Thick x 20.00 x 20.00	Fiberglass Replaceable
C500ATZ	1	30 X 25 X 1	Washable Self-Charging Electrostatic
B500ATZ	2	16 X 20 X 1	
B580ATZ	3	20 X 20 X 1	
B680ATZ	3	20 X 20 X 1	
B840AT	4 4	20 X 25 X 1 20 X 15 X 1	
B960AT	4 4	20 X 25 X 1 20 X 15 X 1	
B1200AT	9	20 X 20 X 1	
B1400AT	9	20 X 20 X 1	
B1600AT	9	20 X 25 X 1	

ENGINEERING ESTIMATING DATA

Noise

Department of Labor, Occupational Safety and Health Administration (OSHA) requirements state that protective devices shall be provided for workers exposed daily to sound pressure levels in excess of 90 dBA for eight hours, 92 dBA for six hours, 95 dBA for hour hours, 97 dBA for three hours, 100 dBA for two hours, etc. The noise level is the total sound pressure level in the worker's environment and is a fuction of the individual noise source, location of the noise source with respect to the worker and the acoustical characteristics of the area. In order for the user to estimate the total noise in a specific installation, NEMA has prepared a handbook **"Sound Level Prediction for Installed Rotating Electiral Machines"**, NEMA publicaton #MG-3-1974 (available from NEMA, 2101 L. Street, Washington D.C. 20037).

The actual noise encountered by the worker is dependent on the noise sources, distance from the noise sources and room characteristics and may be estimated by using the NEMA handbook. Values of motor noise to use in these calculations are shown below.

To meet the requirements of the actual operating condition the data in this section is given in terms of "- dBA sound pressure at 3 feet under conditions of rated current when operated on power supply C at base speed". Values are given by frame diameter for drip-proof guarded, drip-proof with motor mounted blower, totally enclosed fan-cooled and totally enclosed non-ventilated enclosures.

Motor noise may be required in terms of sound power in calculating total noise at an installation. The graph below shows how to convert from sound pressure to sound power levels.Requests for lower noise levels or detailed customer noise specification must be submitted to Reliance Electric for review and quotation.

NOTE - DC motors operated on rectified power produce a characteristic noise, best described as a "hum", which has its origin in the AC ripple voltage inherent in this power source. These AC ripple voltages produce corresponding AC ripple currents in the motor armature circuit, and these periodic currents interact with motor field fluxes to produce periodic forces which can excite vibration of various parts of the motor structure. These ripple currents are more properly termed harmonic currents and their magnitude and number is dependent upon several factors including power supply type, armature circuit inductance and SCR conduction angle. The noise which results from these current harmonic excitation forces may not exceed legal or specified limits. It can be annoying however, because of its high pure tone content.

Noise Level Data

Frame	**Mean Sound Pressure Level, dBA at 3 feet, with motor operating at Base Speed and Full Load on Power Code C (S-6)** Power Supply. Levels are nominal values and may vary +3. -7 dBA on specific motors. All data based on the mean value of four microphone positions under free field conditions (R = infinity). (Refer to Reliance Electric if guaranteed values are required.)															
	NOISE DATA															
	850 rpm				1150 rpm				1750 rpm				2500 rpm			
	DPG	TENV	FV	TEFC	DPG	TENV	FV	TEFC	DPG	TENV	FV	TEFC	DPG	TENV	FV	TEFC
DC180ATZ	58	58	70	58	60	60	73	60	64	64	75	70	71	70	75	73
C180ATZ	58	58	70	58	60	60	73	60	64	64	75	70	71	70	75	73
C2113ATZ	59	59	77	59	65	63	77	63	74	66	77	74	77	70	77	79
C2115ATZ	-	-	82	-	-	-	82	-	-	-	82	-	-	-	82	-
C2512ATZ	60	60	79	60	70	65	79	66	77	74	79	75	87	74	79	83
C2514ATZ	-	-	83	-	-	-	83	-	-	-	83	-	-	-	83	-
C2515ATZ	-	-	83	-	-	-	83	-	-	-	83	-	-	-	83	-
C2812ATZ	63	63	81	63	73	68	81	68	84	75	81	77	90	75	81	86
C2813ATZ	-	-	83	-	-	-	83	-	-	-	83	-	-	-	83	-
C2815ATZ	-	-	83	-	-	-	83	-	-	-	83	-	-	-	83	-
C3210ATZ	71	71	83	71	75	75	83	75	85	75	83	82	91	75	83	93
C3212ATZ	-	-	85	-	-	-	85	-	-	-	85	-	-	-	85	-
C3214ATZ	-	-	85	-	-	-	85	-	-	-	85	-	-	-	85	-
C3612ATZ	78	78	84	78	79	79	84	79	85	79	84	85	93	79	84	94
C3613ATZ	-	-	87	-	-	-	87	-	-	-	87	-	-	-	87	-
C400ATZ	79	79	87	80	80	80	87	82	86	80	87	88	95	80	88	95
C440ATZ	-	-	88	-	-	-	88	-	-	-	88	-	-	-	-	
C500ATZ	-	-	88	-	-	-	88	-	-	-	88	-	-	-	-	-
B500ATZ	-	-	79	-	-	-	81	-	-	-	83	-	-	-	85	-
B580ATZ	-	-	81	-	-	-	83	-	-	-	83	-	-	-	87	-
B680ATZ	-	-	85	-	-	-	85	-	-	-	85	-	-	-	89	-
B840AT	-	-	88	-	-	-	88	-	-	-	-	-	-	-	-	-
B960AT	-	-	88	-	-	-	88	-	-	-	-	-	-	-	-	-

DPG - Drip-proof guarded self-ventilated with internal fan on shaft.

FV - Force ventilated with motor mounted blower with or without filter.

TEFC - Totally enclosed fan-cooled.

TENV - Totally enclosed non-ventilated.

ENGINEERING ESTIMATING DATA

Conversion Of Sound Pressure To Sound Power DB Correction Vs. Distance From Motor(2)

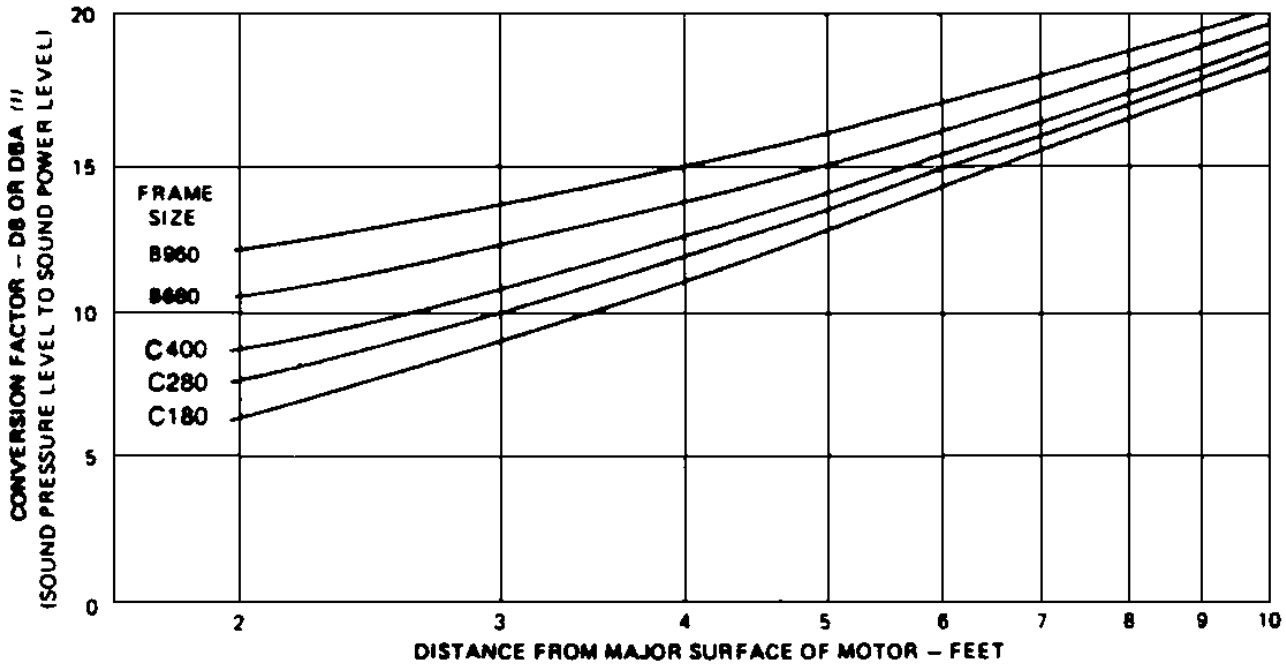
Note: These conversion factors are based on ideal conditions in an anechoic (free field) room. These factors may not be accurate in application environments where room conditions (ambient and reverberation characteristics) may contribute to higher sound intensities at specific locations.

Example:
Sound Power Level = Sound Pressure Level + Conversion Factor

If sound pressure is 80 DBA at 3 feet for a C400ATZ frame and sound power is desired, find 3 feet mark on horizontal axis and follow it up to the C400 curve and read + 10.7 on the vertical axis.
Sound Power: = 80 + 10.7 = 90.7 DBA Sound Power Level.

(1) DBA readings are mean sound pressure level. Values apply to Octave Band, Broad Band DB & DBA.(

2) Graph may also be used to convert sound power to sound pressure level.



ENGINEERING ESTIMATING DATA

Axial Trust Capacity In Pounds For Minimum B-10 Bearing Life of 10,000 Hrs. With No External Overhung Load

Frame	AXIAL THRUST CAPACITY IN POUNDS							
	Horizontal Mounting				Vertical Mounting (1)			
	2500 rpm	1750 rpm	1150 rpm	850 rpm	2500 rpm	1750 rpm	1150 rpm	850 rpm
DC180ATZ	176	207	251	286	190±45	217±45	265±45	295±45
C180ATZ	295	345	417	477	30±45	356±45	430±45	492±45
DC2112ATZ	176	207	251	286	190±45	217±45	265±45	295±45
C210ATZ	510	565	640	700	535±137	590±137	665±137	725±137
C250ATZ	535	595	675	725	580±255	640±255	720±255	770 ±255
C280ATZ	650	725	825	890	715±360	795±360	890±360	995±360
C320ATZ	845	940	1065	1150	920±448	1020±448	1155±448	1236 ±448
C360ATZ	1045	1160	1315	1420	1160±661	1280±661	1445±661	1555 ±661
C4011ATZ	1350	1630	2000	2250	1440±655	1820±655	2210 ±655	2475 ±655
MC4013ATZ	1310	1580	1975	2200	1460±825	1810±825	2200±825	2460 ±825
LC4013ATZ	1280	1550	1920	2175	1450±935	1790±935	2185±935	2450 ±935
C440ATZ	1350	1650	2000	2250	1470±825	1820±825	2210±825	2475±825
B506ATZ	1350	1630	2000	2250	1470±828	1820±828	2210±828	2475 ±828
B507ATZ	1310	1580	1975	2200	1460±942	1810±942	2200±942	2460±942
B508ATZ	1280	1550	1920	2175	1450±1056	1790±1056	2185±1056	2450±1056
B587ATZ	1635	1990	2475	2850	1900±1395	2300±1395	2875±1395	3260 ±1395
B588ATZ	1585	1930	2430	2790	1875±1553	2290±1553	2865±1553	3250 ±1553
B589ATZ	1540	1890	2400	2750	1860±1678	2280±1678	2860±1678	3245 ±1678
B686ATZ	1440	1825	2325	2675	-	2310±2122	2920±2122	3320±2122
B687ATZ	1400	1775	2275	2625	-	2300±2298	2910±2298	3310±2298
B688ATZ	1325	1675	2150	2550	-	-	2900±2616	3300±2616
B842AT	-	2030	2600	3050	-	-	3360±2844	3870 ±2844
B843AT	-	1980	2530	2975	-	-	3350±3082	3865 ±3082
B844AT	-	1925	2480	2925	-	-	3340±3271	3860±3271
B845AT	-	1860	2425	2850	-	-	-	3850 ±3604
B846AT	-	1780	2330	2750	-	-	-	-
B847AT	-	1730	2270	2680	-	-	-	-
B962AT	-	2060	2730	3200	-	-	-	-
B963AT	-	2000	2625	3120	-	-	-	-
B964AT	-	1900	2500	3000	-	-	-	-
B965AT	-	1750	2375	2850	-	-	-	-
B966AT	-	1625	2240	2725	-	-	-	-
B967AT	-	-	2800	3300	-	-	-	-
B968AT	-	-	2700	3200	-	-	-	-
B969AT	-	-	2400	2900	-	-	-	-

(1) Thrust capacity for vertical mounting includes a constant whose value is plus or minus depending on the direction of the thrust load. The constant is plus for thrust loads acting upward against the force of gravity and minus for loads acting downward with gravity.

Radial Load Capacity

Frame	Radial Load Capacities at the End of the Shaft in Lbs (2)			
	2500 rpm	1750 rpm	1150 rpm	850 rpm
DC180ATCZ	310	345	395	440
C180ATZ	500	565	625	625
DC2112ATZ	310	345	395	440
C210ATZ	1075	1125	1125	1125
C250ATZ	1600	1750	1975	2075
UC280ATZ(3)	2700	2700	2700	2700
UC320ATZ(3)	3200	3200	3200	3200
UC360ATZ(3)	4000	4000	4000	4000
UC400ATZ(3)	6000	6000	6000	6000
UC440ATZ(3)	5100	5800	5800	5800
UB500ATZ(3)	3625	4090	4700	5190
UB580ATZ(3)	2275	2275	2275	2275
B680ATZ	Refer to Reliance Electric			

(2) **CAUTION:** The use of these radial load capacities requires the accurate calculation of the radial load for the application. Radial loads for gears, sprockets, and flywheel are usually accurately determined, but the radial loads due to V-belt drives are subject to miscalculations because they do not include all of the pre-tension load (belt tightening). The calculations of the radial load of a V-belt drive must include the pre-tension for transmitting the horsepower, pre-tension for centrifugal force on the belts, pre-tension for high starting torques, rapid acceleration or deceleration, pre-tension for drives with short arc-of-contact between the V-belt and sheave, and low coefficient of friction between belt and sheave caused by moisture, oil or dust.

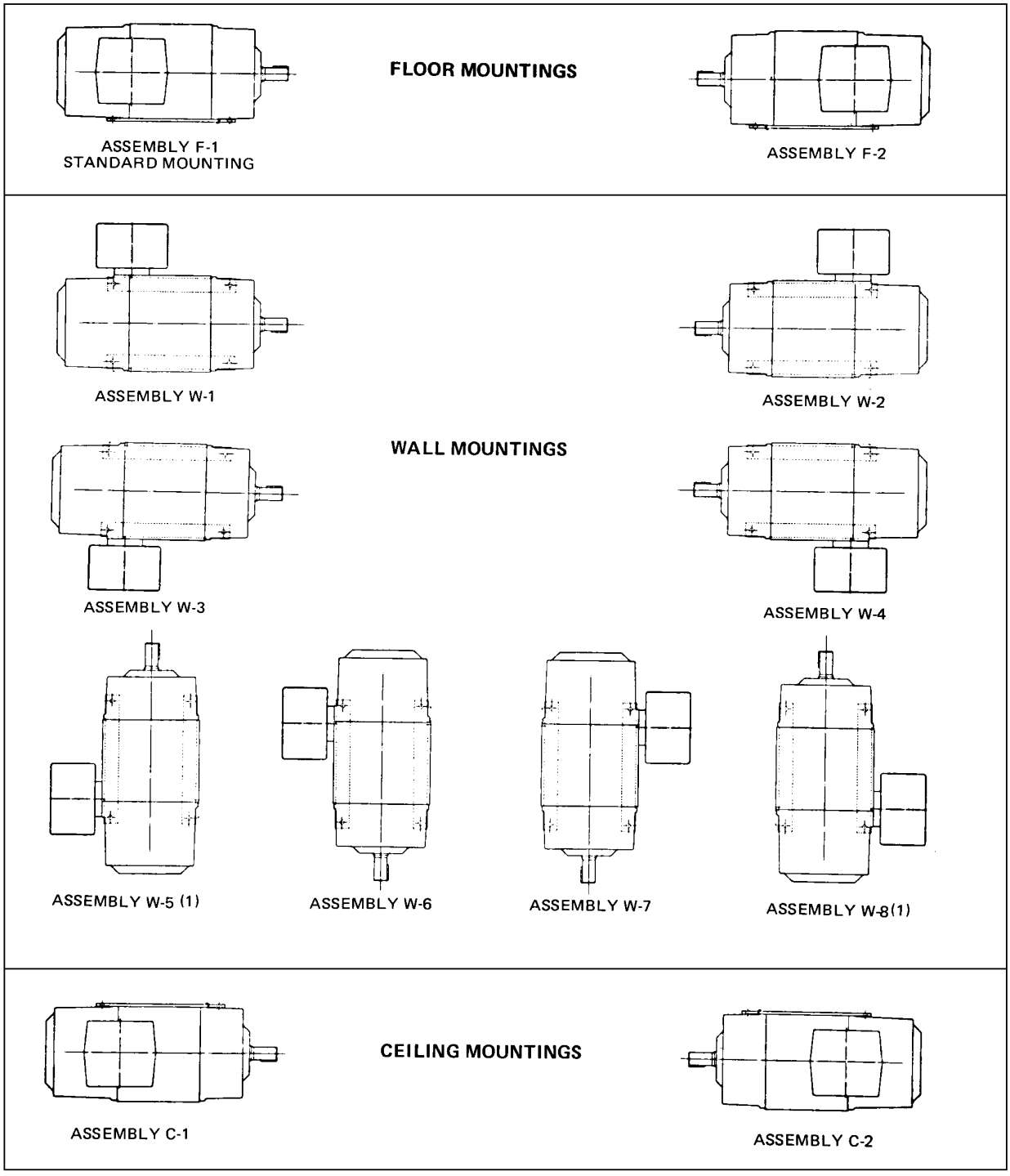
(3) Data for motors with roller bearings at the drive end (back end). Motors with ball bearings at the drive end are for coupled duty only.

SPACE HEATER DATA

AC Single-Phase, 50/60 Hzor DC Voltage

Frame	Volts	Watts	Amps
C180ATZ	120	75	0.62
	240	75	0.31
	480	125	0.26
C210ATZ	120	90	0.75
	240	90	0.38
	480	125	0.26
C250ATZ, C280ATZ and C320ATZ	120	140	1.17
	240	140	0.58
	480	125	0.26
C360ATZ	120	250	2.08
	240	250	1.08
	480	165	0.35
C400ATZ	120	250	2.08
	240	300	1.25
	480	280	0.58
C440ATZ	120	306	2.55
	240	306	1.28
	480	306	0.64
C500ATZ	120	400	3.33
	240	400	1.67
	480	400	0.83
B500ATZ	120	400	3.33
	240	400	1.67
	480	400	0.83
B580ATZ	120	575	4.8
	240	575	2.4
	480	770	1.6
B680ATZ	120	770	6.4
	240	770	3.2
	480	770	1.6
B840ATZ	120	1440	12
	240	1535	6.4
	480	1535	3.2
B960ATZ through B1600AT	120	1920	16
	240	2570	10.7
	480	2570	5.3

MOTOR MOUNTING ASSEMBLY SYMBOLS



(1) Frame sizes C180ATZ with position W5 or W8 mounting not available with drip-proof guarded e enclosure. Available only in guarded configuration or may be supplied as drip-proof guarded-force ventilated with motor mounted blower.

DIMENSION SHEET INDEX BY ENCLOSURE

Dimension Sheet Index	
DC Motor Enclosure Definitions	
DPG-FV	Drip-Proof Guarded Force Ventilated With Blower & Filter (Optional)
DPG-SV	Drip-Proof Guarded Separately Ventilated
DPG	Drip-Proof Guarded (Self Ventilated)
SPG-FV	Splash-Proof Guarded Force Ventilated With Blower & Filter (Optional)
SPG-SV	Splash-Proof Guarded Separately Ventilated
SPG	Splash Proof Guarded (Self Ventilated)
TENV	Totally Enclosed Non-Ventilated (Self Ventilated)
TEFC	Totally Enclosed Fan Cooled
TEAO-Inline	Totally Enclosed Air Over Inline
TEAO-PB	Totally Enclosed Air Over Piggyback
TEPV	Totally Enclosed Pipe Ventilated (Pipe In - Pipe Out)
TEDC-AA	Totally Enlosed Dual Cooled Air-To-Air Heat Exchanger
TEDC-AW	Totally Enclosed Dual Cooled Air-To-Water Heat Exchanger
NVXP	Totally Enclosed Non-Ventilated Explosion Proof
FCXP	Totally Enclosed Fan Cooled Explosion Proof

Enclosure	Mounting	Frame Size	Dimension Sheet Index	
			Motor	
			NEMA	IEC
DPG-FV & SPG-FV	Foot	DC180ATZ	609982-501	-
	NEMA AC C-Face & Shaft	DC180ATCZ	609982-503	-
	D-Flange	DC180ATDZ	609982-505	-
	Foot	C180ATZ	609982-1	-
	NEMA AC C-Face & Shaft	C180ATCZ	609982-33	-
	D-Flange	C180ATDZ	609982-5	-
	Foot	C210ATZ	616002-1	-
	NEMA AC C-Face & Shaft	C210ATCZ	616002-23	-
	Foot	C250ATZ	616012-1	-
	NEMA AC C-Face & Shaft	C250ATCZ	616012-23	-
	Foot	C280ATZ	616022-1	-
	NEMA AC C-Face & Shaft	C280ATCZ	616022-23	-
	D-Flange	C280ATDZ	616022-5	-
	Foot	C320ATZ	616032-1	-
	D-Flange	C320ATDZ	616032-5	-
	Foot	C360ATZ	616042-1	-
	D-Flange	C360ATDZ	616042-5	-
	Foot	C400ATZ	609962-1	-
	D-Flange	C400ATDZ	609962-5	-
	Foot	C440ATZ	616492-1	-
	Foot	C500ATZ	616870-1	-
	Foot	B500ATZ	609902-4	-
	Foot	B500 - B680	609902-21	-
	Foot	B840AT	609902-19	-
	Foot	B967AT - B969AT	609902-1101	-
	Foot	B1600AT	609902-271	-

DIMENSION SHEET INDEX BY ENCLOSURE (con't)

Enclosure	Mounting	Frame Size	Dimension Sheet Index	
			Motor	
			NEMA	IEC
IP23-IC06	Foot	GK1104 - GK1110	-	616077-601
	Foot	GK1303 - GK1311	-	616007-601
	Foot	GK1606 - GK1610	-	616017-601
	Foot	GK1808 - UGK1810	-	616027-601
	Foot	GK2008 - ULGK2010	-	616037-601
	Foot	GK2208 - ULGK2210	-	616047-601
	Foot	GK2508 - UGK2510	-	616067-601
	Foot	GS2806 - GS2810	-	615380-1
DPG, SPG & TENV	Foot	DC180ATZ	609980-501	-
	NEMA AC C-Face & Shaft	DC180ATCZ	609980-503	-
	Foot	C180ATZ	609980-1	-
	NEMA AC C-Face & Shaft	C180ATCZ	609980-23	-
	Foot	C210ATZ	616000-1	-
	NEMA AC C-Face & Shaft	C210ATCZ	616000-23	-
	Foot	C250ATZ	616010-1	-
	NEMA AC C-Face & Shaft	C250ATCZ	616010-23	-
	Foot	C280ATZ	616020-1	-
	NEMA AC C-Face & Shaft	C280ATCZ	616020-23	-
	Foot	C320ATZ	616030-1	-
	Foot	C360ATZ	616040-1	-
	Foot	C400ATZ	609960-1	-
TEFC	Foot	DC180ATZ	609981-513	-
	Foot	C180ATZ	609981-13	-
	Foot	C210ATZ	616001-13	-
	Foot	C250ATZ	616011-13	-
	Foot	C280ATZ	616021-13	-
	Foot	C320ATZ	616031-13	-
	Foot	C360ATZ	616041-13	-
TEAO-Inline	Foot	C180ATZ	609981-16	-
	Foot	C210ATZ - C280ATZ	609951-16	-
	Foot	C320ATZ - C360ATZ	609971-16	-
TEAO-PB	Foot	C210ATZ - C280ATZ	609951-19	-
	Foot	C320ATZ - C360ATZ	609971-19	-
	Foot	C400ATZ	609961-19	-
DPG-SV, SPG-SV & TEPV	Foot	DC180ATZ	609983-501	-
	Foot	C180ATZ	609983-1	-
	Foot	C210ATZ	616003-1	-
	Foot	C250ATZ	616013-1	-
	Foot	C280ATZ	616023-1	-
	Foot	C320ATZ	616033-1	-
	Foot	C360ATZ	616043-1	-
	Foot	C400ATZ	609963-1	-
	Foot	C440ATZ	616493-2	-
	Foot	B960AT	609903-13	-
	Foot	B1200AT	609903-47	-
	Foot	B1400AT	609903-48	-
	Foot	B1600AT	609903-49	-

DIMENSION SHEET INDEX BY ENCLOSURE (con't)

Enclosure	Mounting	Frame Size	Dimension Sheet Index	
			Motor	
			NEMA	IEC
TEDC-AA	Foot	EB500ATZ	609905-325	-
	Foot	FB500ATZ - FB680ATZ	609905-8	-
TEDC-AW	Foot	B500ATZ - B680ATZ	609905-6	-
	Foot	B840AT	609905-423	-
	Foot	B967AT - B969AT	609905-428	-
	Foot	B1200AT	609905-422	-
NVXP	Foot	XC180ATY - XC259ATY	609985-2	-
	NEMA AC C-Face & Shaft	XC180ATY - XC259ATY	609985-4	-
FCXP	Foot	XC180ATY - XC259ATY	609986-2	-
	NEMA AC C-Face & Shaft	XC180ATY - XC259ATY	609986-4	-
	Foot	XC320ATZ - XC360ATZ	609975-2	-
	Foot	XB500ATZ	609904-27	-

Modifications	Frame Size	Dimension Sheet Index
Slide Bases	DC180ATZ	609987-501
	C180ATZ	609987-1
	C210ATZ - C280ATZ	609957-1
	C320ATZ - UC360ATZ	609977-1
	UC400ATZ - UC440ATZ	609977-4
	UB500ATZ - UB680ATZ	609907-2
Oversized Conduit Box	C210ATZ - C280ATZ	609959-1
	C320ATZ - UC360ATZ	609979-1

Notes